COMPTON'S
PICTURED ENCYCLOPEDIA AND FACT-INDEX

Interesting · Accurate · Up-to-date

TO INSPIRE AMBITION,
TO STIMULATE THE IMAGINATION, TO PROVIDE THE
INQUIRING MIND WITH ACCURATE
INFORMATION TOLD IN AN INTERESTING
STYLE, AND THUS LEAD INTO
BROADER FIELDS OF KNOWLEDGE,
SUCH IS THE PURPOSE OF
THIS WORK

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COMPTON'S PICTURED ENCYCLOPEDIA

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Here and There in This Volume

At odd times when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit faraway countries, watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study guide. For these purposes consult the Fact-Index and the Reference Outlines.

Pictures You Will Enjoy

For the Reading Hour

Parent and Child, School and Home

High Lights in History's Pageant

Travel Views at Home and Abroad

In the Plant and Animal World

Marvels of Science and Invention

The World at Work

Guideposts to Literature, Art, and Music

Exploring a World of Facts

Interest-Questions Answered in This Volume

KEY TO PRONUNCIATION

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index. Marked letters are sounded as in the following words: cāpe, ăt, fär, fȧst, whạt, fạll; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, dọ; cūre, bŭt, rụde, fụll, bûrn; *out*; ü = French *u*, German ü; ġem, ğo; *th*in, *th*en; ṅ = French nasal (Jeaṅ); *zh* = French *j* (*z* in azure); *K* = German guttural *ch*.

D

DACE Most of the minnows in creeks or in the shallows of clear lakes belong to the tribe of fishes called daces One of the commonest is the black nosed or striped dace also known as the brook minnow It grows only three to four inches long A bold black stripe runs from the tip of its nose to the base of its tail The back is olive

A MINNOW THAT SHOWS OFF IN SPRING

A prize beauty among our fishes is this trim l ttle minnow, the red bellied dace (*Ch osomus eryth ogaster*) At spawning time in spr ng it dresses up n scarlet black and gold People like to watch it flash its colors in aquar ums

green the underside silvery white At spawning time in spring or early summer the male s fins are tinged with red and the black stripe is bordered with bronze This dace is found from New England to Minnesota and south to northern Alabama and Virginia

The common shiner or redfin is a favorite bait of bass fishermen It lives in every state except Texas and south Atlantic states It has a deep flat body with silvery sides and an olive-green back It grows to be from five to eight inches long During the spawning season in May and June the male under goes marvelous changes in color Its fins turn red and its back becomes an iridescent blue Its sides glow vividly with all the colors of the rainbow

The horned dace or creek chub is the giant of the tribe It grows seven to ten inches long and gives a real thrill to boys who catch it with hook and line It lives from Maine to Wyoming and south to Alabama Its body is a dusky blue with a black spot at the base of the dorsal fin This is bordered with red in the male In the spawning season through May and July the male s head turns orange and shows hornlike growths

Many other daces live in North America Europe and Asia The daces belong to the family *Cyprinidae* with the carp and goldfish (*see* Carp Goldfish) They have only one fin on their backs and the rays of this dorsal fin are usually soft and without spines They have remarkable lips which they can thrust forward to seize small plants and animals at the bottom of lakes and streams They chew with a few powerful teeth in their throats for their jaws have no teeth at all

Daces and related minnows occur in fresh waters throughout the world except South America Australasia and Madagascar Scientific name of black nosed dace *Rhinichthys atronasus* of common shiner *Luxilus cornutus* or *Notropis cornutus* of horned dace *Semotilus atromaculatus*

DAHLIA (*dăl yȧ* or *dāl yȧ*) The Spanish conquerors of Mexico were the first white men to see the dahlia This flower grows wild in the mountains of Mexico and Guatemala and was cultivated by the Aztecs It was introduced into Europe in 1789 and named in honor of Anders Dahl Swedish botanist

The parent wild flower is flat with a yellow center and eight single scarlet rays Modern varieties may be double and globular in shape The plants are from 18 inches to 12 or more feet high and range in color from white through yellow orange red and purple

Dahlias bloom according to variety from June to November They will thrive in almost any well drained garden soil They must be protected from the wind and sometimes must be tied to stakes to keep the brittle stalks from breaking The soil around the plants should be t lled regularly and in dry weather they should be frequently and freely watered

The plants may be grown from seed or cuttings by grafting to perpetuate rare varieties or by division of the tuberous roots Amateur gardeners commonly use the last method When frost has killed the tops the roots should be dried for a few hours and then stored in a cool cellar secure from frost to be replanted early in the spring

Growing from seed produces many variet es as the seedlings do not reproduce all the characteristics of the parents In the north the seed dahlias are often started under glass in winter to be sure they will bloom the next summer or autumn

THE DAHLIA REPAYS CARE

In return for spec al attent on the dah a w ll burst into large and showy blooms l ke th s one It is a favorite w th amateur gardeners

The American Dahlia Society classes the thousands of varieties as follows single orchid flowering anemone collarette peony star incurved cactus straight cactus semi cactus formal decorative informal decorative ball miniature and pompon

Dahl as form a genus of the family *Compositae* The nomen lature of the several spec es is confused because they so closely resemble one another *Dahlia pinnata* also known as *Dahlia variabilis* and *Dahlia rosea* is the parent of most of the varieties that grow in our gardens today *Dahlia juarezi* is the parent of the important group known as the cactus dahlias

DAIRYING—*One of Our* GREATEST INDUSTRIES

Here is a short route from cow to bottle. With a modern electric milking system like this, one operator can milk 50 or more cows an hour. The cows stand contentedly while their milk is drawn into glass jars and then on through sanitary pipes directly to the pasteurizer, then to a holding vat, and finally to a bottler.

DAIRYING. In 1841 Thomas Selleck, a station master on the New York and Erie Railroad, asked a farmer to try shipping milk by rail 60 miles to New York City. The farmer agreed. On the day of the "big haul," 240 quarts of milk in a big, blue wooden churn were successfully shipped to the city. Soon other farmers in many other states were shipping milk into cities. From this small beginning has grown today's large and important American dairy industry.

Milk—as fluid and dry milk, butter, cheese, or ice cream—supplies about one fifth of all the food eaten by the people of the United States. The amount of milk needed to meet the demand is enormous.

A few years after those first few quarts of milk were shipped to New York in the wooden churn, wooden containers for shipment were replaced by metal cans. Sometimes big pieces of ice were put on the tops of the cans to keep the milk cool. Keeping milk fresh during its train ride, however, continued to be a problem until mechanical refrigeration began to be used between 1880 and 1890. Today tank cars and tank trucks carry thousands of gallons of cold, fresh milk without changing its temperature more than a degree or two even on a 500-mile trip.

Mechanical refrigeration is also important to cool and keep fresh other dairy products such as butter, ice cream, cheese, and concentrated milk. Fifty years ago an ice-cream plant as large as those we use today, would have required hundreds of tons of ice each day. Today, an ice-cream plant manufactures, stores, and delivers ice cream without the use of a single pound of ice. Frozen concentrated milk, which may soon join orange juice in the family freezer, will make mechanical refrigeration even more important.

The modern dairy farm is the first chapter in the story of this great industry. The article on Milk tells how milk is produced on a dairy farm, how it is collected at the country receiving station, how it is processed at the dairy plant, and how it is distributed (*see* Milk).

Keeping Books on the Cow

To tell which cows are profitable milkers, the dairyman must know the quantity given by each cow. In order to grade the milk he must also know how much butterfat it contains. Milk contains from 2 to 8 per cent butterfat. The invention of the Babcock test in 1890 by Dr. S. M. Babcock, of the Wisconsin Agricultural Experiment Station, provided a convenient and practical means of testing for butterfat. This test also made it possible to detect the adulteration of milk by skimming or watering. Dr. Babcock generously refused to patent his discovery for his own financial profit. A notable fact is that for almost three quarters of a century no basic change has been made in this testing method. Today, milk and cream worth 4½ billion dollars are marketed annually in the United States, mainly on the basis of the butterfat content which is determined by the Babcock method.

In the Babcock test, which now is universally used in the United States and Canada, a little sulfuric acid is added to measured samples of the milk to be tested. This frees the butterfat and dissolves all the other milk solids. Then these samples in individual test bottles are put into a machine called a *centrifuge* where they are whirled around rapidly. This causes the butterfat to separate from the milk, which is heavier. The butterfat rises to the top, so that the amount can easily be read from a scale on the neck of the test bottle.

How the Cream Separator Works

The power cream separator was another invention that made great changes in dairying. Before it came into use between 1880 and 1890 the *gravity method* of cream separation was used. In the gravity method pans of milk stood on the shelves of the dairy house for 24 to 36 hours until the cream rose and could be skimmed off by hand. This method left from 10 to 20 per cent of the fat in the skimmed milk.

Today modern creameries use centrifugal cream separators, which vary in size from those small enough to skim the milk of one cow to machines that handle many thousands of pounds of milk an hour. These machines leave less than 0.01 per cent of fat in the skimmed milk.

The cream separator works on the principle that the heavier a whirling body is, the greater its tendency to fly from the center. From a tank at the top the milk flows down into a large bowl or drum, making from 5,000 to 9,000 revolutions a minute. The cream,

being lighter stays in the center and is drawn off through a tube The heavier skimmed milk flying to the outside, is carried away through another tube

How Butter Is Made

The articles on Ice Cream and Cheese tell how these products are made Butter is the natural fat of milk When the cream from which butter is to be made arrives at the dairy it is weighed and tested for bacteria and butterfat content Next it is *fore-warmed* in a tank and then it is pasteurized

From the pasteurizer it flows into a cooler and then into a holding tank The holding tank keeps the cream at the correct temperature until it is pumped into the churn Enough cream is pumped into the churn to half fill it An average churning of butter takes as much as a ton or more of cream

The cream is now churned until butter particles as large as a pea or a kernel of corn are formed The buttermilk is then drained off cold water is pumped in and the butter is again churned to wash it The water is then drained off salt is added and a final churning mixes in the salt evenly Now the butter is creamy and tastes like the good butter we spread on our bread Pictures on this page show how butter is shaped into solid form and how it is packaged

How Milk Is Bought

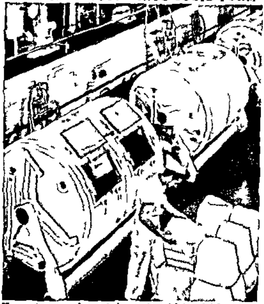
In the early days dealers bought milk directly from dairymen Much milk is still bought this way in smaller communities Under this *direct-purchase* method the dealer posts the price he will pay and the dairyman accepts the price or finds another market

With the rapid growth of the industry however, dairymen s co-operative associations were developed By working together in these associations dairymen found they could get more money for their milk

Before the first World War there were only 14 co-operative milk producers associations Today almost every local milk producing and purchasing area—called a *primary market*—has one or more co-operatives These co-operative milk producing associations negotiate prices with dealers and operate price plans affecting milk surpluses A second kind of co-operative may also have country receiving stations transportation facilities and processing plants Sometimes dairymen also form co-operative distributing associations to compete with private distributors Farmers also organize dairy herd improvement associations and in co-operative breeding associations farmers pool their money to buy better bulls than individual members could afford (*see also* Cooperative Societies, Cattle Agriculture)

Dairymen are paid for their milk under a formula called a *blended price* This price varies according to how much of the total milk supply is bottled canned made into butter ice cream cheese or other products State and federal laws regulate milk prices in large market areas The geographic area from which a city obtains its milk is called a *milkshed* New York City has the largest milkshed in the United States It includes more than 45 000 farms and 430 country receiving stations in ten different states and two Canadian provinces with the most distant shipping point more than 500 miles away State and federal laws also regulate sanitary

SHAPING BUTTER INTO SOLID FORM



Here rich creamy butter is being shaped into solid form after it has left the churns From here the shaped butter is sent to a cold room where it must harden before it can be packaged.

PACKAGING BUTTER FOR MARKET

In the butter packaging room large blocks of butter cut to just the right size and shape by a fine wire are sent through a packaging machine One kind of machine may form the butter into quarter pounds wrap each piece in a protective wrapping and then package it in paraffined pound cartons

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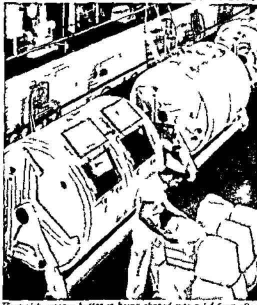

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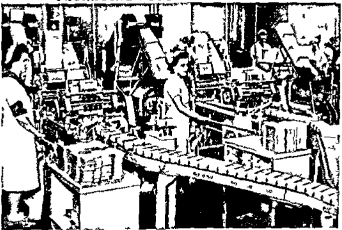

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milk production as well as distribution throughout the United States.

Growth of a Dixie Dairying Belt

Traditionally, the United States "dairy belt" has included the states stretching from New England west to Wisconsin, Iowa, and Minnesota. (*See* Farm Life.) This area has a climate suitable for raising dairy cattle, since most cattle do not thrive in severe temperature extremes. Rainfall in this area helps grow hay and pasture crops on which cattle feed. For these same reasons a broad area in southeastern Canada is also a fine dairy belt. (*See* Canada; Milk.) Recently the dairying industry has also grown rapidly in the southern part of the United States.

Before the second World War most states in the South had to have a large part of their fresh milk shipped from the North. During and after the war, many Southern farmers turned from cotton and other field crops to dairying. They made the change partly because people wanted more milk and partly because dairying is a comparatively stable type of farming. Two factors helped make the change successful. Research had shown which grasses and legumes could be planted to make good year-round pastures. Attention to scientific breeding had shown how to produce better livestock. The use of Brahman cattle from India for breeding and crossbreeding helped produce herds that could stand hot weather better than native breeds (*see* Cattle).

History of Dairying

Since the beginning of history man has owned cattle and used their milk. Milk was an important item 6,000 years ago, according to ancient Sanskrit records. The Bible refers to milk, butter, and cheese, the promised land being described as "a land flowing with milk and honey."

Cheese was an important article of commerce in ancient Rome. In Europe during the Middle Ages, monks developed the art of cheese making. Holland and Switzerland were the two early centers in the development of the dairy industry in Europe. The English apparently learned the use of milk for butter and cheese making from the Romans.

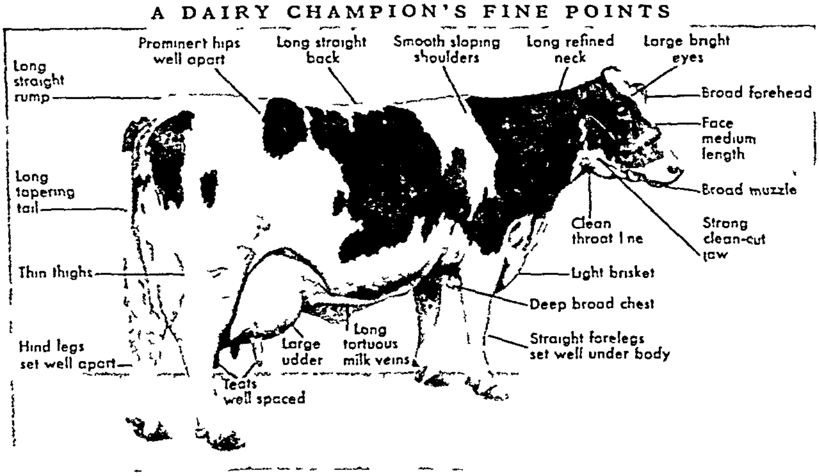
Cheese was an important item in the diet of the vikings who sailed the seas on long voyages. On his second voyage Columbus brought the first cattle to America. It has been said that one of the reasons for the high death rate among the *Mayflower* party was the fact that they brought with them to America no cattle and thus had no fresh milk to drink.

The development of dairying was slow for a hundred years after the first settlement in the colonies. Early settlers brought cattle with them, but there was no scientific breeding such as we know today. The cattle were allowed to mix as they pleased.

In the early days each household had its "family cow," or milk was bought from a neighbor. Dairy products such as butter and cheese were made on the farm. As America grew, few city families continued to keep cows. For a time dairymen kept their herds in the cities, but sanitary regulations soon prevented this. During this period there still was doubt about the value of pasteurizing milk (*see* Pasteur). In 1892 Nathan Straus, a civic-minded New York businessman, became interested in providing pure milk for children. In 1893 he established the first infant milk depot in America, where he offered sterilized milk for sale at five cents a quart or one cent a glass. This and similar efforts caught the public's imagination and influenced the improvement in the quality of the country's milk supply.

Improvement in the dairy industry also came about through the invention of the glass milk bottle by Hervey D. Thatcher in 1884 and the development of certified milk in 1893. The new bottle protected milk from contamination, and the rules concerning certified milk set a high standard for the dairy industry which has been maintained up to the present day. Now some dairies bottle milk in square waxed-paper containers, which are used only once.

A DAIRY CHAMPION'S FINE POINTS



This is a photograph of the champion dairy cow Carnation Ormsby Madcap Fayne of the Carnation Milk Farms, Seattle, Wash. In her record year, "Capper" gave 41,943.4 pounds of milk, a daily average for a year of about 55 quarts. This cow, a Holstein-Friesian, illustrates perfectly the qualities that make a fine dairy animal.

Size of the Modern Dairy Industry

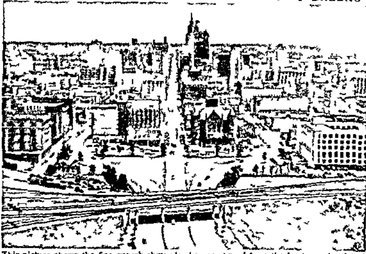
People in American villages, towns, and cities buy about 60 million quarts of milk a day. Farm families use more than 15 million quarts produced on their own farms. Manufacturers of dairy products buy about 75 million quarts a day. In addition to the $2\frac{1}{2}$ million people on the dairy farms the number employed in processing and delivering dairy products is estimated at 250,000. One out of every 15 United States

families is dependent upon the dairy industry for a livelihood

Modern distributors prepare many products in addition to milk cream butter cheese and ice cream Some of these products are plastic cream (which contains 65 to 80 per cent butter fat) powdered milk buttermilk chocolate milk drink commercial sour cream and cottage cheese Others which may have additional healthful qualities are acidophilus milk yogurt vitamin D milk fat free milk and soft curd milk (For chart *see* Milk)

Goats which are sometimes called the poor man s cow also supply healthful milk Goats milk is easy to digest because its fat globules are smaller than those in cow s milk and it has a softer curd (*see* Goat)

A SUPERHIGHWAY REACHES THE HEART OF DALLAS



This picture shows the fine superhighway leading westward from the business district of Dallas Beyond the railroad overpass is Dealey Plaza with the turreted county courthouse in the background Here is the restored cabin of the first settler John Neely Bryan

DAISY The day s eye as it was known in Old English is like a miniature sun surrounded by its rays These beautiful wild flowers carpet meadow and roadside from May until November

The common field or ox-eye daisy is a species of chrysanthemum native to Europe (*Chrysanthemum leucanthemum*) Tradition says that it was a stow away in hay brought to America to feed the horses of General Burgoyne s army Its white blossoms from one to two inches across are borne on smooth erect stems from one to three feet high

The true or English daisy (*Bellis perennis*) is white tinged with pink the wee modest crimson tipp'd flower of which the poet Burns sang It has one representative in America (*Bellis integrifolia*) which grows from Kentucky southwest to Texas The blackeyed Susan or yellow daisy (*Rudbeckia hirta*) is a handsome and common flower

The striking Shasta daisy a hybrid developed by Luther Burbank has a gold center with white petals in a circle from four to six inches across Christmas and Michaelmas daisies are species of asters All daisies are members of the family *Compositae*

DALLAS, TEX In 1841 an Indian trader named John Neely Bryan built a log cabin against the east bluff of the Trinity River Little more than one hundred years later this former trading post had grown into a city of almost half a million people Today Dallas is the second largest city in Texas

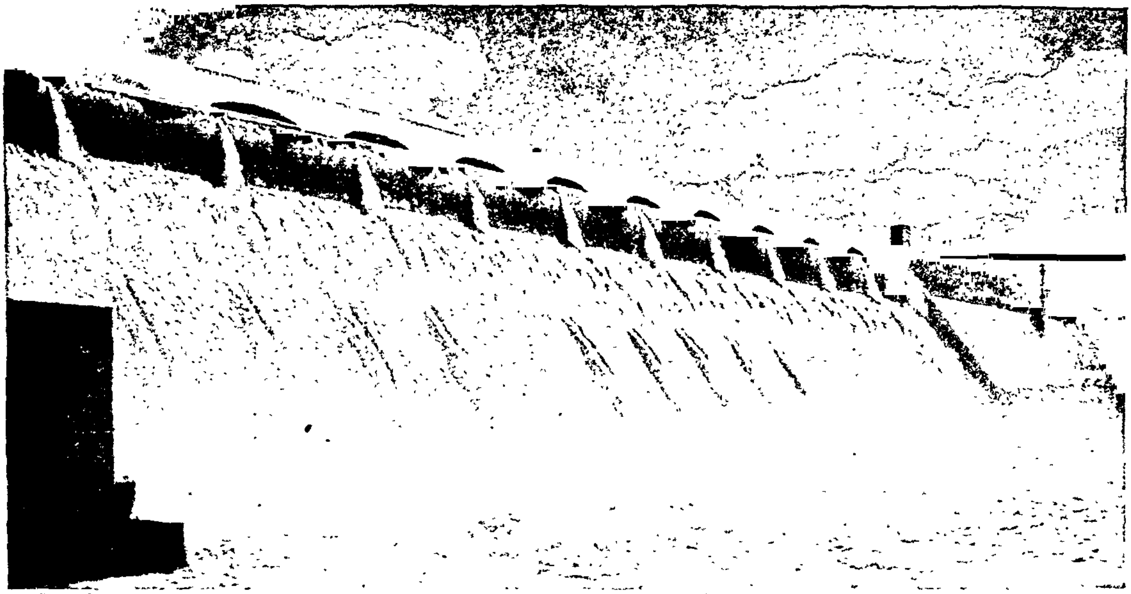
Dallas owes much of its rapid growth to its location Draw a circle around it with a radius of a hundred miles and you take in some 2 million people about one fourth of the population of Texas The city is in the midst of the fertile Blackland Belt a rich cotton growing region Dallas is one of the largest inland cotton markets in the world Vast oil fields nearby place the city among the foremost oil capitals of the nation Dallas is the home of the Federal Reserve Bank of the Eleventh District and is a leading insurance and financial center It also has important manufactures particularly farm implements and machinery cotton products and leather goods

Known as Big D to many people of northern Texas Dallas is a modern well planned city It is noted for its towering skyscrapers broad streets and fine parks The annual state fair at its civic center Fair Park is one of the largest in the country Leading educational institutions in the city include Southern Methodist University Baylor University s schools of dentistry and nursing Dallas Theological Seminary and Southwestern Medical College of the University of Texas

More than a century before Bryan built his cabin French traders had visited the site to barter with the Caddo Indians In 1841 Texas gave a land grant to a company headed by William S Peters of Kentucky to promote settlement of the region Three families joined Bryan in 1842 and others came steadily First the settlement was called Peters Colony but in 1845 it was named for George Mifflin Dallas vice-president of the United States under Polk The town was surveyed in 1846 and incorporated as a city in 1871 one year before the first railroad reached the site By 1900 the population was still only 43 000 There after it surged forward as the surrounding area began to develop oil fields large-scale cotton growing and other sources of wealth

Dallas adopted manager council government in 1931 Between 1928 and 1931 the city straightened the Trinity River to reclaim land and control floods Part of the ten mile Central Expressway through the city was opened in 1949 In 1951 Dallas annexed an area of about 21 square miles that had a population of more than 12 000 Population (1950 census) 434 462

TAMING *Great* RIVERS *with* *Mighty* DAMS



Here is the most massive thing ever made by man—the Grand Coulee Dam on the Columbia River in the state of Washington. Everything about it is big. Its reservoir extends 151 miles to the Canadian border. No other single source of hydroelectric power exceeds it. The world's greatest pumps lift water for irrigation up to a vast plateau. A multipurpose project, besides irrigating farms and generating power, it improves navigation downstream.

DAM. Like the beaver, man builds dams. The beaver erects a wall of branches, stones, and mud across a stream to hold back the water, and in the pool created he builds his house. Man from the beginning of recorded history has also constructed barriers across rivers and other water courses to store or divert water.

Dams were first used to water farms. The ancient Egyptians built earth dams that raised the river level and diverted water into canals to irrigate fields above the river. The Moors carried a knowledge of irrigation from Egypt and Babylonia to Spain. Here on the Segura River is an 800-year-old dam. Soon after the Pilgrims came to the New World, they too built dams. By 1682 pent-up water from dams turned their water wheels to grind corn and saw timber.

Contrast these simple dams with the great dams of today. The mightiest structure ever made by man is Grand Coulee Dam on the Columbia River in Washington. It towers 550 feet and is 4,173 feet long. All three of the great Pyramids of Egypt could be put inside of it. The dam contains enough concrete to build a highway across the United States and back. Its spectacular waterfall is twice as high as Niagara Falls. Behind the dam, the waters of the Columbia River pile up to form a lake 151 miles long, with water enough for 2,000 gallons for every person on earth.

The artificial lake backed up by a dam is called a *reservoir*. That part of a dam over which the flood waters flow to the river below the dam is the *spillway*. Water may pass over the crest of the dam itself, or near the dam in chutes, tunnels, or shafts. A *sluice* is a passage through the dam itself for lowering the water level of the reservoir. Pipes for conducting water to the power turbines are called *penstocks*. The flow of water through spillways, sluices, and penstocks is regulated by *control gates*.

Why Men Build Dams

Dams are built primarily for irrigation, water supply, flood control, electric power, and improvement of navigation. Many modern dams are multipurpose and serve more than one of these purposes.

Irrigation dams store water to equalize the water supply for crops throughout the year. Irrigation is a primary purpose, for example, of Hoover Dam (Boulder Dam from 1933 to 1947) on the Colorado

AN EARLY DAM IN DAM-BUILDING PROGRESS

Compare this old dam and mill in Devonshire, England, with the mammoth Grand Coulee Dam shown above. The water passing over the wheel turns a millstone which grinds grain.

River Before the dam was built the Colorado flooded the farms of the Imperial Valley in California and the Yuma Valley in Arizona when the mountain snows melted and it became a sluggish stream in the long dry summer Now the dam saves the floodwaters and provides a steady supply of water for irrigation (*see* Colorado River)

Dams are used for irrigation also when a river has cut its bed far below the land to be irrigated The Grand Coulee Dam serves such a purpose A huge plateau almost as large as Delaware lies hundreds of feet above the Columbia River From the reservoir created by the dam the world s largest pumps lift water to another man made lake on the plateau From there water flows in canals to the farmlands (*see* Columbia River)

Some dams divert rivers into irrigation canals or pipelines Imperial Dam across the Colorado River is an example It diverts water from the river into the All American Canal for irrigation of the Imperial Valley in California and into the Gila Canal for irrigating the Gila Valley in Arizona many miles away (*see* Irrigation)

Water supply dams collect water for domestic industrial and municipal uses for cities such as New York Los Angeles San Francisco and Boston These cities do not have suitable lakes or rivers nearby for a water supply (*see* Aqueducts Water Supply)

Flood control dams impound flood waters of rivers and release them under control to the river below the dam The best examples are the five dams in the Miami River valley They were built to protect Dayton Ohio, after a serious flood in 1913 (*see* Floods)

Navigation dams are built to maintain a minimum depth of water for ships To illustrate the Ohio River formerly was too low for navigation six months of the year Now a stairlike series of 46 dams and locks on the river maintain a uniform water depth

Shipping may be blocked by a waterfall or rapids A dam with a lock can drown the obstruction Such a dam at Louisville Ky permits passage around the Falls of the Ohio River

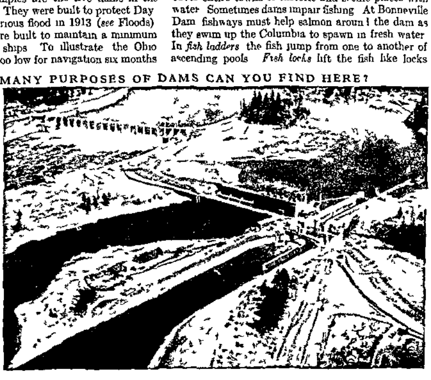
Hydroelectric power dams are built to generate electric power by directing water in penstocks through *turbines* wheels with curved blades as spokes The falling water spins the blades of the turbines connected to generators (*see* Turbine)

Power dams are expected to generate power to repay the cost of construction The output depends first upon the *head* of water or height of stored water above the turbines The higher the water the more weight and pressure bear upon the turbine blades A second factor is the volume of water throughout the year The minimum flow in dry months fixes the amount of *firm power* which customers can rely upon to receive regularly Sometimes extra power or *run-of stream power* generated in flood seasons can be sold usually at lower rates (*see* Water Power)

These are the main purposes of dams but there are other benefits Their reservoirs provide recreation such as fishing and swimming They become refuges for fish and birds Dams conserve soil by preventing erosion They slow down the water of streams so that the water does not carry away the rich topsoil (*see* Conservation)

Dams also create problems Their reservoirs may cover entire towns or historic and scenic places with water Sometimes dams impair fishing At Bonneville Dam fishways must help salmon around the dam as they swim up the Columbia to spawn in fresh water In *fish ladders* the fish jump from one to another of ascending pools *Fish locks* lift the fish like locks

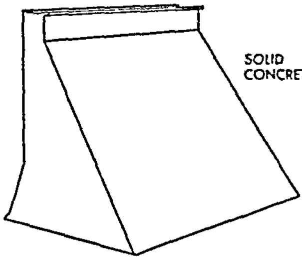
HOW MANY PURPOSES OF DAMS CAN YOU FIND HERE?



Bonneville Dam on the Columbia River typifies the modern multipurpose dam. The power house generates electricity The dam and lock raise the water level and improve navigation The huge reservoir retains floodwaters to control floods To aid conservation of fishing fish ladders or steplike pools and fish locks which work like ship locks help salmon get upstream to spawn.

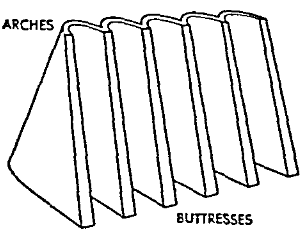
MAN BUILDS MANY TYPES OF DAMS, EACH

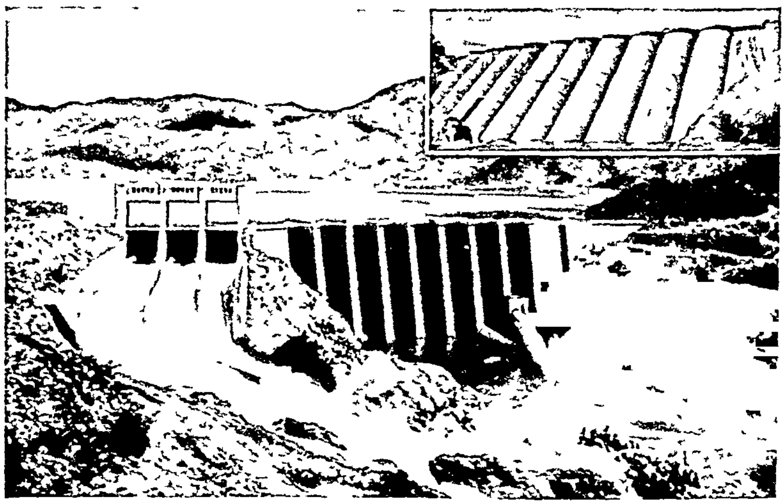
SOLID GRAVITY DAM



Fontana Dam on the Little Tennessee River in North Carolina rises 480 feet, the highest dam of the TVA. Made of solid concrete it holds back the water by its own weight. It is thicker at the base than at the crest. This is the most common type of all concrete dams. It is also the most permanent type of dam and requires the least maintenance.

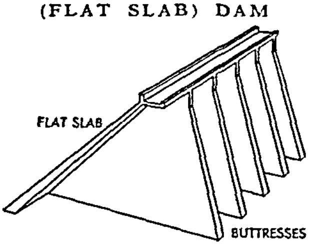
HOLLOW GRAVITY OR BUTTRESS (MULTIPLE ARCH) DAM

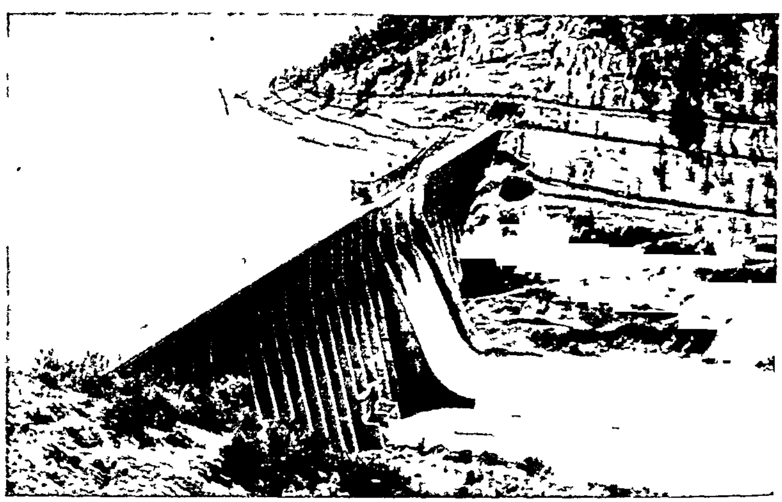




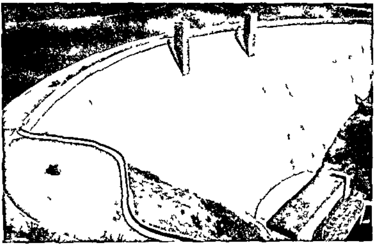
Bartlett Dam, 287 feet high, on the Verde River in Arizona is the world's highest concrete multiple-arch dam. It resists water pressure more by its design than by its weight and requires less material than the solid gravity dam The small view shows the reinforced concrete arches, shaped like half cylinders, resting against triangular buttresses.

HOLLOW GRAVITY OR BUTTRESS (FLAT SLAB) DAM

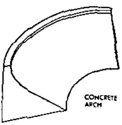




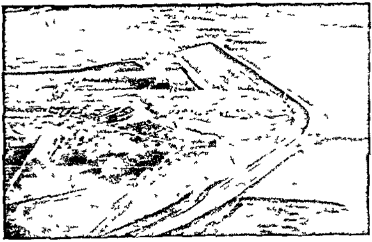
Stony Gorge Dam is on Stony Creek, a tributary of the Sacramento, in California It requires less concrete and is less costly than the solid gravity type It depends upon its structure more than its weight to withstand the force of the water. Its relatively thin facing is supported by buttresses. The slab and buttresses are reinforced concrete.



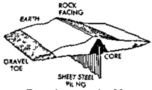
ARCHED DAM



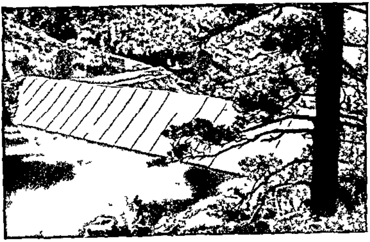
Here is Hungry Horse Dam, the world's third highest dam. It stands across a deep narrow canyon on the South Fork of Flathead River in Montana. *It is of the arch-gravity* type, relying upon its weight and its arch form for strength. Its great concrete arch curves upstream to transfer the tremendous water load of its reservoir to the canyon walls.



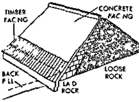
EARTH DAM



Fort Peck Dam on the Missouri River in Montana is the largest dam in volume in the world. It is an earth dam of the hydraulic fill type. Sand, gravel, silt and clay were delivered and distributed at the dam by water in 28-inch pipes. A cut off wall of sheet steel piling and a watertight core of fine material prevent seepage under and through the dam. Gravel toes give stability to the slopes. A heavy layer of rock on the upstream face protects the dam against water and ice erosion.



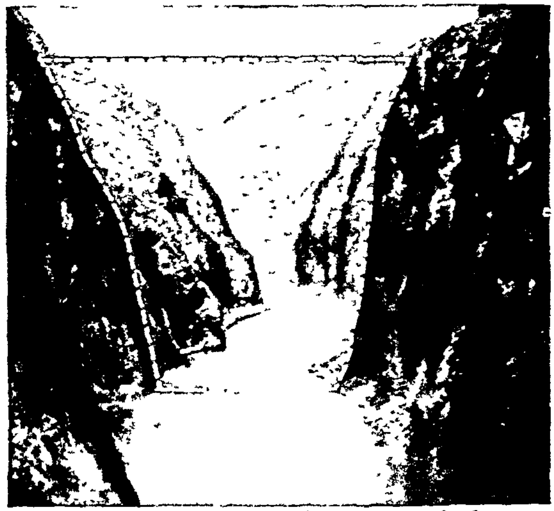
ROCK DAM



Salt Springs Dam on the North Fork of the Mokelumne River in California *is 328 feet high, the world's highest* rock dam. First, loose rock was dumped across the river. Then rock was laid on the upstream side to equalize settlement and to act as a cushion for the concrete facing. This watertight facing was next built of reinforced concrete slabs. The timber facing nailed to the concrete prevents leaks if the concrete cracks.

FIRST STEPS IN THE CONSTRUCTION OF HOOVER DAM

Here is a model of Hoover Dam on the Colorado River. Much preliminary work must be done before construction begins. An early step is testing in the laboratory with numerous scale models of plaster, rubber, and concrete.



This is the site of Hoover Dam before construction began, looking upstream through Black Canyon. It was finally selected from 70 sites that had been explored. The broken line shows approximately where the dam was to be built.

lift ships. Another problem of dams is silting. Some rivers pick up clay and sand and deposit them behind the dam, thereby lessening its usefulness.

There are structures related to dams. *Cofferdams* are temporary dams built to hold water back so that work can be done. *Dikes* keep the sea off land that is below sea level. *Levees* are artificial riverbanks constructed high enough to prevent flooding. A dam across a river intended to permit flow, once a certain depth of water has been reached, may be called a *barrage*. A small dam that forms a millpond or fishpond is called a *weir*.

Main Types of Dams

Dams are classified into types depending upon their materials, design, and method of construction. The usual types are concrete or masonry, earth, rock, steel, timber, and movable dams. Plain or reinforced concrete is more often used than masonry in dams in the United States today. Concrete dams are either solid gravity, hollow gravity, or arched.

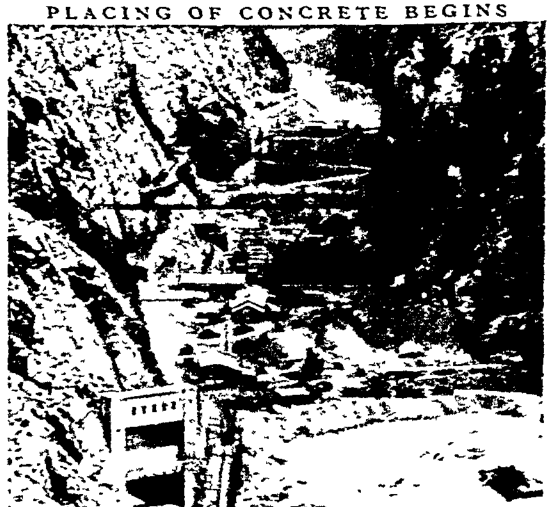
Solid gravity dams are made of solid concrete. They withstand the pressure or push of water by their weight. In cross section, they are like a triangle, broad at the base and narrow at the crest. They are built in this shape because water pressure behind the dam becomes greater with the depth of water. Whether a dam backs up water one mile or a hundred miles is not important. Pressure depends, not upon how far water is backed upstream, but upon its depth at the dam.

Hollow gravity dams are made of less concrete than solid gravity dams. They rely more on their structure than their weight to resist the force of the water. They have a thin facing supported at an incline by a series of triangular buttresses, or piers. Hollow gravity dams may be of three types. The *multiple arch dam* consists of a number of arches supported on buttresses, while the *flat slab dam* is a straight wall resting against buttresses. Similar to the multiple arch dam is the *multiple dome dam*, which has domes instead of arches. Coolidge Dam on the Gila River in Arizona is an outstanding example of this type of construction.

Arched dams consist of a horizontal curve using the principle of the arch for strength against water pressure (*see* Arch). They are curved upstream. The force of the water is transmitted to the canyon walls.

Earth dams are made by building an embankment of gravel, sand, and clay across a river. To prevent leakage, often a *core*, or inner wall, of concrete or

PLACING OF CONCRETE BEGINS



Cofferdams upstream and downstream block the river and it flows around the dam site in tunnels (such as at lower left). Buckets suspended from cableways place concrete in the forms. A plant for cooling concrete is in front of the dam.

other watertight materials is used In a *rolled-fill dam* earth is hauled by vehicles onto the dam and rolled tight with heavy machinery In the *hydraulic fill dam*, earth is carried to the dam by water in pipes or flumes and also deposited by the water The placing of the earth is so controlled that the finer, watertight materials form the core and the coarser materials make up the shells of the dam In the *semi-hydraulic fill dam* trucks bring the earth to the dam and jets of water distribute the materials

Rock dams are made by dumping rocks across the river A wall of rocks is then la d on the upstream side and over this is built a waterproof facing of reinforced concrete, timber or steel

Steel dams have not been used much in the United States They are similar in shape to flat slab dams

Timber dams once numerous are still built where timber is abundant Some are made by covering the upstream face of A shaped frames with planks Others are timber cribs or frames filled with rocks

Movable dams are of many types They are built mainly to raise the water level for navigation when the river is low During flood time they are removed or collapsed Some are automatic and r se or sink with the water level Others require machinery to operate them *Bear trap dams* consist of huge leaves hinged to the upstream and downstream sides of the foundation By admitting water under the leaves the trap is raised into an A-shaped structure A *roller dam* is made up of great hollow steel cylinders which roll up and down inclined tracks at their ends

How Dams Are Built

The methods of building dams may be seen by following the construction of Hoover Dam built between 1930 and 1935 The engineers constructed a concrete arch-gravity dam at an approved cost of $165 000 000 It is as tall as a 60-story skyscraper Its crest is 45 feet thick and its base 650 feet It stores the entire flow of the Colorado River for two years

Much exploratory and preliminary work had to be done The engineers made geologic and topographic surveys to select the best site They made maps of 70 possible locations bored holes to test the rock for a sound foundation and studied the river for its speed high water level and s lting

Once the location was chosen des gners made the r plans They then made models to test their design Where once had been burning desert engineers built Boulder City to house more than 5 000 workers Construction gangs built railroads and highways for transporting great quantit es of equ pment and materials—san l gravel steel and 5 million barrels of cement

Workmen strung cables across the canyon from pairs of towers which travel on tracks along opposite sides of the site Each of the five cableways could carry 25 tons Two of them had spans of nearly half a mile Construction crews also built a great gravel screening plant and two huge concrete mixing plants

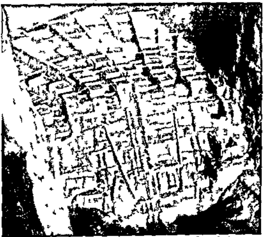
Four 50-foot tunnels two on each side of the river were drilled and blasted from the solid rock of the canyon walls They were used to divert the river around the site Later the tunnels became spillway outlets and penstocks for the power plant

Next temporary cofferdams of earth and rock were built upstream and downstream from the dam site to block the river and to prevent it from backing up

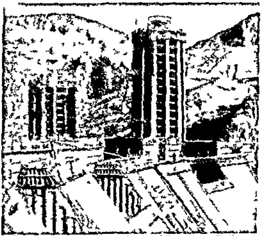
High scalers stripped tons of loose and projecting rock from canyon walls The *overburden* or loose rock and muck was dug out to expose the bedrock *Grout* or a thin mortar of cement and water was next forced into the foundation to fill seams and holes

Forms were made for buil ling the dam in enormous blocks Concrete was poured into the forms from eight-cubic yard buckets traveling on the cableways As

HOOVER DAM TAKES SHAPE BLOCK BY BLOCK



Hoover Dam was built in enormous blocks Water in hundreds of miles of pipes buried in the concrete removed the heat of setting cement Grout (cement and water) forced between the blocks made the dam one solid piece



Here the dam rises to near the top of the canyon In the background are intake towers for the penstocks of the power plant The concrete blocks are locked together by vertical keys For the completed dam see next page

AN "X-RAY" OF THE COMPLETED HOOVER DAM

This is the completed dam. The "X-ray" drawing shows how it works. The Nevada wall of Black Canyon is shown solid, but the Arizona wall has been cut away to reveal construction inside the rock. The fluted cylinders behind the dam are intake towers, and pipes leading from them are penstocks. These convey water to the turbines in the powerhouse at the foot of the dam. While the dam was being built, the four large tunnels, two on each side of the river, diverted the river around the dam site. Today the upstream ends of these tunnels have been plugged. Now they serve as penstocks and spillway outlets.

each block of concrete dried, grout was pumped between the blocks, making the dam one solid piece

Cooling so gigantic a structure was done by a system of pipes Cold water in 528 miles of one-inch pipes imbedded in the concrete carried off the heat Without this system, the dam would have taken a century to cool because of the heat given off by the setting cement The concrete would have shrunk and cracked

Refrigerating pipes were also used to freeze landslides of wet earth at Grand Coulee Dam Another problem at this dam was the possible freezing of the control gates in winter temperatures of −28° F A mammoth heating apparatus was installed in the spillway and gates Steel plates some 1,100 square feet in area, are heated by electric wiring

Famous Dams of the United States

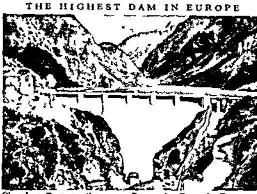
On the great rivers and lesser streams of the United States many dams have been built by private industry as well as by federal state or local governments Federal dams usually are constructed by United States Army engineers if navigation is involved and by the Bureau of Reclamation for irrigation projects A modern development is the planning of entire river basins as regional units This usually involves building many multipurpose dams on the main streams and their tributaries

On the Columbia River are Grand Coulee and Bonneville dams Under construction in Washington are McNary and Chief Joseph dams On tributaries are Anderson Ranch Dam on the South Fork of Boise River in Idaho and Hungry Horse Dam on the South Fork of Flathead River in Montana Key structures of the Central Valley Project in California are Shasta Dam on the Sacramento River Friant Dam on the San Joaquin River, and Folsom Dam rising on the American River

On the Colorado River are Hoover, Parker, Imperial and Davis dams Chief dams on the Rio Grande are Elephant Butte and Caballo both in New Mexico On the Missouri is Fort Peck Dam in Montana and under construction are Oahe and Fort Randall in South Dakota and Garrison in North Dakota

In the Tennessee Valley project are 24 major dams and several smaller ones Heart of the TVA are nine dams on the Tennessee largest of which is Kentucky Dam 8 422 feet long The highest is Fontana 480 feet in height on the Little Tennessee in North Carolina (*See also* articles on individual rivers)

THE HIGHEST DAM IN EUROPE



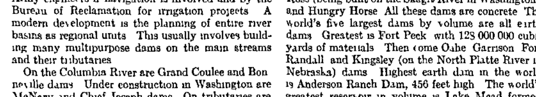
Chambon Dam on the upper Romanche River in France is Europe s highest dam It is 450 feet high and about 1,000 feet long Completed in 1935 it is for electric power and flood control

Many of these dams are outstanding in the world The highest dam ever built is Hoover Dam 726 feet in height Next in order are Shasta Grand Coulee, Ross (being built on the Skagit River in Washington), and Hungry Horse All these dams are concrete The world's five largest dams by volume are all earth dams Greatest is Fort Peck with 128 000 000 cubic yards of materials Then come Oahe Garrison Fort Randall and Kingsley (on the North Platte River in Nebraska) dams Highest earth dam in the world is Anderson Ranch Dam, 456 feet high The world's greatest reservoir in volume is Lake Mead formed by Hoover Dam Its capacity is 31 142 000 acre-feet Next largest are the reservoirs of Garrison Oahe Fort Peck and Grand Coulee dams Oahe Dam will have the longest reservoir some 275 miles long

Notable Foreign Dams

The largest dam and power station in Europe is Dnieper Dam in Russia The next largest is Genissiat Dam on the Rhone River in France Mettur Dam on the Cauvery River is India's greatest irrigation project One of the oldest great dams in the world is Egypt s irrigation dam Aswan on the Nile finished in 1902 On the Blue Nile in Anglo-Egyptian Sudan is Sennar Dam also for irrigation The largest reservoir for irrigation in Australia is that of Hume Dam on the Murray River Shipshaw Dam No 1 on the Saguenay River is one of the largest power dams in Canada Gatun Dam forms Gatun Lake, which is part of the route of the Panama Canal (*See also* in FACT INDEX dams by name and the table under Dam)

THE MIGHTIEST WONDERS MADE BY MAN



Here we see how Grand Coulee and Hoover dams compare in size with other gigantic man made structures and with Niagara Falls *Grand Coulee Dam on the* Columbia River is by far the biggest structure ever built. It is the largest concrete dam in volume in the world. The cataract that pours over the dam s spillway is more than twice as high as Niagara Falls Hoover Dam on the Colorado River is the highest dam in the world. It is about half the height of the world's tallest building the Empire State Building

THE "STREET WHICH IS CALLED STRAIGHT"

This street, covered through much of its length, cuts through a maze of crooked streets from the east to the west gate of Damascus. Here in New Testament days lived the Apostle Paul.

DAMASCUS, SYRIA. Airplanes roar over the ancient city of Damascus, capital of Syria. Giant air-cooled, diesel-powered buses race across the desert sand from Baghdad, making the 600 miles in less than two days, where camel caravans take a month. Taxis and street-cars rattle over the cobblestones; gas and electricity brighten streets and homes. Up-to-date hotels and government buildings rise along tree-bordered streets in the "new" city. In factory areas stand textile, tanning, canning, match, and glass plants. Modern activities, however, mean little to the Arabs of old Damascus. They live much as they did in Biblical times, and the city is a fortress of Moslem culture and spirit.

Situated in a fertile, green oasis watered by the Barada River at the foot of the Anti-Lebanon Range, Damascus has been called the "pearl of the desert." On the irrigated plain grow olives, grapes, oranges, citrons, pomegranates, figs, pears and other fruits, nuts, wheat, barley, tobacco, and vegetables.

The ancient wall which embraced the old city is now in ruins, and suburbs have spread beyond it. From a distance the great expanse of low-lying Arab houses, overtopped here and there by the graceful minarets and domes of more than 200 mosques, is very picturesque. When you come nearer, however, you find that the streets are narrow and crooked and indescribably filthy, and the white houses with their grilled windows and red shutters look very dingy and dilapidated. The mud walls, however, sometimes conceal a magnificent private dwelling, built around a beautiful courtyard with a central fountain.

The Khans and the Bazaars

The life of this merchant city of the desert centers in its khans (walled caravan headquarters) and its bazaars. The "great khan," with its Moorish gate and black and white marble cupola supported by marble pillars, is a magnificent structure. In this and in other lesser khans, trading goes on in a cool twilight to the pleasant sound of fountains.

The bazaars are simply streets lined with shops, stalls, and cafés. Some of the shops are hardly larger than bootblacks' parlors. A tremendous din prevails as men dicker and haggle. Each kind of goods has a street or a part of a street to itself: the Street of the Saddlers, the Street of the Slipper Merchants, the Street of the Water-Pipe Makers, the Street of the Spice Men, the Street of the Dyers, etc. The longest and busiest thoroughfare of all is the famous "Street Which Is Called Straight," mentioned in the Bible in connection with St. Paul's conversion to Christianity.

Famous for Handicraft

The looms of Damascus have been famous for many centuries; and in this city, where everything is still done in the most primitive way, where meal is ground in stone mills turned by camels, you may still see the hand looms worked by a weaver and his draw boy. On these looms are made the beautiful damasks that were known throughout Europe and Asia as early as the time of the Crusades.

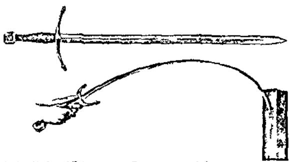
The Damascus blades, for which Damascus was also noted in the Middle Ages, have not been forged here since the 14th century, when Timur Leng, the terrible Tatar conqueror, raided the city and carried off all the great armorers to his own capital. These blades were so keen that they could cut a floating web; so hard that they would shear an iron spear in two as if it were a reed; so elastic that they would bend to a right angle and then spring back as straight as ever. The painstaking twisting and welding of two grades of iron or steel gave them their cutting properties and also produced a beautiful watermark pattern. To make the swords and scimitars still more attractive, the handles were inlaid with gold and silver in marvelous designs. Damascus today is still famed for exquisite inlay and filigree work.

Prominent in Ancient and Modern History

There are no records of when Damascus was founded. It was thriving when Abraham "followed the course of the sun into foreign lands," and is said to be the oldest city in the world. It is rich in historical memories of the early Christian missionaries and of its capture by the Crusaders. Here died the sultan Saladin, foe of the Crusaders, and here he lies buried.

The first mention of Damascus is in Egyptian records of four thousand years ago. After 1200 B.C. the

THE FAMOUS BLADES OF DAMASCUS



Like the blades of Toledo Spain Damascus swords have been celebrated the world over for their superb workmanship razor sharp edges and perfect temper Many of the handles were inlaid with gold and silver

kingdom of Damascus became a powerful state that long defied Assyria In 732 B C however Tiglath Pileser III king of Assyria took the city The Bible tells of David s conquest of Damascus In 333 B C it fell prey to Alexander and in A D 63 to Rome From 636 to the time of the first World War Damascus was in Arab and Turkish hands except for a brief interval when it was held by the Crusaders in the 12th century After the war Syria was made a mandate of France In 1925 a nationalist uprising occurred and Damascus suffered extensive damage from bombardment by the French During the second World War the city was occupied by United Nations forces (*see* Syria) Population (1944 cen us) 291 157

DAMOCLES The uncertainty of human happiness is illustrated by the story of Damocles who was one of the courtiers and flatterers of the elder Dionysius tyrant of Syracuse in Sicily in the 4th century B C According to the story Damocles once extolled in the highest terms the grandeur and happiness of the king Instead of being pleased the king reproved Dionysius in a singular way He was placed at a magnificent banquet surrounded by all the splendor of royalty In the midst of his enjoyment suddenly looking upward he saw a naked sword hanging by a single horsehair above his head typifying the uncertainty of a ruler s life The sword of Damocles has thus become a proverbial expression for uncertainty and danger

DAMON AND PYTHIAS There is no more *beautiful story of friendship* than that told in ancient times of Damon and Pythias Pythias (or more properly Phintias) was condemned to death because he opposed Dionysius tyrant of Syracuse He begged to be allowed to return home to bid farewell to his wife and child Damon came forward and offered himself as surety for his friend promising to die in his stead if Pythias did not *return*

The time of execution *approached Pythias had* not come and Damon was already at the place where he was to die when Pythias suddenly rushed through the crowd into his arms His horse had been killed and it was only through an almost superhuman effort that he was able to arrive in time Then each of the friends pleaded to be allowed to die for the other Dionysius was so moved that he pardoned them both and begged that he might be allowed to share in their marvelous friendship

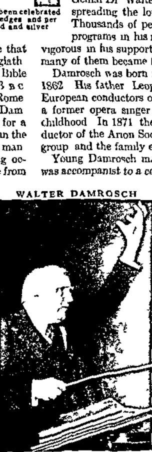
The Knights of Pythias a fraternal society founded at Washington D C in 1864 takes its name from the Pythias of this story

DAMROSCH WALTER JOHANNES (1862–1950) Genial Dr Walter Damrosch devoted his life to spreading the love of good music in America Thousands of people heard their first classical programs in his radio concerts He was equally vigorous in his support of unknown composers and many of them became famous

Damrosch was born in Breslau Silesia on Jan 30 1862 His father Leopold was one of the foremost European conductors of his day and his mother was a former opera singer Walter studied music from childhood In 1871 the elder Damrosch became conductor of the Arion Society a New York City choral group and the family emigrated to America

Young Damrosch made rapid progress At 16 he was accompanist to a concert violinist At 18 he was elected permanent conductor of the Newark Harmonic Society When his father died in 1885 Walter succeeded him as conductor of both the Oratorio Society and the New York Symphony Society His father also had contracted with the Metropolitan Opera to conduct a season of German opera Walter Damrosch finished the season and took the company on tour The next year he was appointed second conductor of the Metropolitan under Anton Seidl In 1890 Damrosch married Margaret Blaine daughter of the American statesman James G Blaine They had four daughters

WALTER DAMROSCH



Papa Damrosch pioneered in broad casting class cal music

In 1895 Damrosch founded the Damrosch Opera Company Eight years later he reorganized the New York Symphony Society into a permanent orchestra During his 24 years as its conductor Damrosch made many tours to cities that had never heard symphonic music In 1925 he broadcast the first radio concert Later he began a radio series for children Although not a musical genius Damrosch *had substantial musical taste He composed six operas* and several cantatas and groups of songs

EXPRESSION *through* MOVEMENT *in* DANCING

Two University of Wisconsin students are shown here in a dance composition of their own creation. Miss Margaret H'Doubler, professor of dance at the university, did much to establish creative dancing as an integral part of education in America.

DANCE. Movement is the first form of expression. Children make themselves understood through movement long before they can talk. They smile or frown to show pleasure or pain. They point, wave, and hold out their arms to be lifted. Long after people can talk—all through life, in fact—they express themselves through movement. They shrug, raise their eyebrows, and use their hands to tell a thought or emphasize a meaning. They make less literal, usually unintentional, statements with their bodies. They walk with a swing when they are happy and stiffly when they are angry. Their shoulders droop when they are sad and lift if something cheers them.

Usually when children are very young they learn the pleasure of rhythmic movement, of skipping, hopping, or walking "in time," with or without music. They may learn too that it is fun to pose, as children do when they "play statues." In posing, they are expressing a meaning, but they are also creating pictures with their bodies.

All these elements of movement are the material from which dance is made. Dancing has been defined as rhythmic movement which does not accomplish a practical purpose. (Rowing a boat, for example, is rhythmic movement, but it is not dancing.) Dancing may make direct statements, almost like speech, through everyday gestures converted into pantomime. It may make less direct statements through less literal kinds of movement. And it always creates a design or picture in space.

What Dancing Gives to the Dancer

People may dance just for the fun of rhythmic movement. Dancing then is a kind of play. When people dance this way in couples, they are using a means which boys and girls and men and women have of enjoying each other's company. When they do it in larger numbers, as in square dancing, the feeling of belonging to a group is added.

Dancing can be a creative experience. All people, especially when they are young, have thoughts and feelings they cannot put into words These are important, and the urge to express them is great. Dancing may be the best medium, since movement is as natural as speech and often more expressive.

Modern dance has found an important place in American schools and colleges for this reason. It is based on controlled natural movements of the body. Without using pantomime, it conveys meaning through movement. Young dancers learn to say with their bodies things they would otherwise have to leave unsaid. This dancing is not *self* expression, but a statement of the dancer's feelings about life. (Modern dance and other types are discussed again later in this article.)

THE ELEGANCE OF BALLET

Ballet is a disciplined art. Only years of concentrated effort can give a dancer the poise and technique displayed above by Edith Allard, young American dancer.

Ballet dancing also may be expressive, but its appeal is first of all to the eye. The ballet dancer must always create a beautiful pattern in space. The technique is traditional and involves movements which are not natural. It requires special training The young dancer gets his chief satisfactions from mastering a difficult technique, learning to use his body to create design, and developing an understanding of professional ballet.

In tap and soft-shoe dancing there is the pleasure of fast rhythmic movement and intricate steps skillfully performed. This dancing appeals especially to people with a touch of

showmanship—who like to entertain

From Creative Experience Into Art

Technique consists of the characteristic movements of a particular type of dance. Form is the way these movements are put together. Form gives unity to a dance by composing the parts into a coherent whole. It enables the dancer to convey meaning to others and to give aesthetic pleasure.

When a person dances in response to his own need, technique and form are not important, though they may increase his satisfaction. But when dancing is performed for the effect on an audience, it becomes either art or entertainment or a combination of the two. Then mastery of technique and the use of form are essential. These are achieved only through serious study beyond the high school or amateur level.

THESE STUDENTS CREATE THEIR OWN DANCES

Here again we see University of Wisconsin students. They are members of Orchesis, the university dance group. Every year Orchesis presents a program of dances which is well received by the students and the public.

Some colleges have excellent dance departments where young people can get a good foundation in the modern dance. Theatrical dancing calls for training in professional schools. Ballet training should begin at 8 or 9 years, with toe work at 11 or 12. People who intend to make ballet a career need regular intensive training between 14 and 18.

Little Children Dance

Children may begin to dance as young as three or four years. They are happy just dancing around the house without music. Or hearing music makes them dance. At about five they may enjoy dancing to the music of their own phonograph records. Rhythmic games and make believe in nursery school or kindergarten and later in the primary grades foster all their dance impulses.

A Saturday class may be desirable if a child is interested. A good teacher using free-dance methods guides her pupils in rhythmic movement and coördination. She lets them develop creatively by encouraging them to make up their own dances.

What Dancing Gives to the Watcher

A good dance performance pleases the eyes. There is aesthetic pleasure in seeing people move beautifully and create satisfactory designs in space. Dancing may appeal to the emotions through a story or idea. Musical accompaniment gives pleasure through the ears.

But dancing as an art form yields its deepest satisfaction through communication between the dancer and the watcher. All movement has a psychic accompaniment called metakinesis (*mĕt-a-kĭ-nē sĭs*), which gives it meaning. Muscular sympathy, known as kinesthetic (*kĭn-ĕs-thĕt'ĭc*) sympathy, enables a receptive watcher to experience the psychic accompaniment of a dancer's movements and in doing so to share in the meaning and emotion of the dance.

SQUARE DANCING PROVIDES FUN AND COMPANIONSHIP

In the picture at the left the dancers are doing a grand right and left. At the right, "Swing your partner" enlivens the dance. These pictures were taken in the field house of a public park in Chicago. Schools and recreation centers throughout the United States provide opportunities for teen agers to get together for square dancing.

Dancing through the Ages—Primitive to Modern

NO ONE knows when man first danced. Archeologists believe he has always danced, that he danced before he formed sounds into words. Thousands of years ago cave men made drawings and paintings of men and animals on the walls of their cave homes in southwestern Europe. They drew hunters in wide leaps in the act of shooting a bow, or with arms swung wide after the release of an arrow (for pictures, *see* Drawing). They drew other figures leaping and springing in typical dance movements. Archeologists tell us that these pictures portray ritual dances in which the hunters expressed the success they hoped to achieve in war or in hunting.

DANCE IN THE BELGIAN CONGO

To the beat of tom-toms and the jangling of their own ornaments, these little African girls are performing an ancient tribal dance of the Ngbandi.

Actual knowledge of such ancient dancing is limited. But there are many regions, particularly in Africa, Australia, the Americas, and island groups, where native races are still at a primitive level of culture or have been within historical times. Students find that the dancing of all these peoples has basic characteristics in common. A comparison of existing dances with relics such as the cave paintings and stone images leads to the conclusion that primitive people have always danced for the same reasons and in similar ways.

AN AFRICAN ARISTOCRAT DANCES

The young man with the spears is a page to the "Intore," or sultan, of the Ruanda district in Central Africa. The Intore's pages, chosen from the best families, are famous for the beauty of their dances.

Primitive people do not understand many things—birth, love, sickness, death, day and night, winds and storms, the sun and moon and stars, the change of seasons, and the beauties of nature. They hope for many things—an abundance of food, victory in war, many children, fertility of their animals and crops. Not having words with which to express their emotions and desires, they use rhythmic movements of their bodies. They whirl and leap and stamp, lift their arms, bend their bodies, kick and bounce. They shout and chant and sing and clap their hands and beat on drums to time the rhythm of their dances.

This first dancing of any people has the technical name *primitive dance*. There are at least three kinds. Magic or religious dances are performed to worship a deity, to initiate a priest, to secure abundance of food (in hunting, fishing, or farming), and to cure sickness. Medicine men or priests who have been trained from childhood usually direct this type of dancing. Dances with a social or tribal purpose are performed at the birth of a child, at the initiation of boys and girls into tribal life, at marriages, at secret-society initiations and ceremonies, and when war is imminent or in progress. Play dances, or recreational dances, are done just for the fun of dancing—for sheer pleasure in physical movement. In these, the dancers may "show off" their athletic skill and endurance.

Forms of the Dances

Everywhere the basic steps of primitive dance are similar, with wide, expansive movements for the men and small, mincing, close-to-earth steps for the women. Although tribal dances sometimes appear wild and unpatterned, they always have rigid rules. Among some tribes, a mistake on the part of a dancer is punished with death. All members of the tribe—men, women, and children—take part, if not throughout the dance, then during some phase of it. Dancing serves to keep the group solidly united. Sometimes members of a tribe are excluded for a brief period, when they are in mourning, for example. But at the end of the period they are welcomed back with a dance festival.

Most primitive peoples have pantomime dances in which they imitate by movement and gesture what they wish brought about. When they want victory in war they dance a victory dance. Before they go out to hunt they mimic a successful hunt. When they

want rain for their crops, they dance a rain dance Some of the earliest of all dances imitate the movements of animals. These may be simple imitation, a means of recording observation They may acquire magic or religious meaning, as in hunt dances and dances involving a sacred animal Or they may be performed for comic effect

All Dance Stems from the Primitive

As a people advances from a primitive state into civilization, their dancing changes in several directions The dancing of a racial group may develop into an art form The entire group no longer takes part There are performers and watchers The performers go through rigid training The watchers understand the religious, artistic, and social meaning of every movement of the dancing This is *ethnologic dance*—an art expression of a race Almost all the dancing of the Orient with which Westerners are familiar is of this type Only a homogeneous culture produces it

The livelier phases of primitive dancing may develop into the *folk dance* of the common people This type exists for the pleasure of the dancers not for the entertainment or artistic enjoyment of an audience (*see* Folk Dance). Side by side with it appears the *social dance* of the upper classes, which has a remote source in the more sedate phases of primitive dance As a civilization becomes more complex or more democratic, the folk elements tend to disappear from recreational dancing Social dance, which is individualistic, remains

Theatrical dance is farthest away from the primitive in spirit Other names for this type are *spectacular* and *stage* dance. It may call upon primitive, ethnologic, folk, and even social dancing for inspiration But it is something put together by many individuals not the expression of a race or community Such different types as tap dancing ballet, and exhibition ballroom dancing belong to this category

Dancing in the Ancient Civilizations

When the ancient Egyptians first carved ideographs they used a picture of a dancing man to represent joy or happiness Paintings and carvings found in tombs and elsewhere throughout Egypt show that dancing was highly developed and played an important part in the lives of the people The dancers were priests or slaves attached to the temples and slaves in the service of wealthy landowners They danced in honor of the gods and at births, marriages, funerals, and all royal functions

The so-called Egyptian dances seen today on the stage and in motion pictures probably bear little resemblance to the originals These modern dances imitate poses shown in the ancient pictures But the artists who created the pictures did not understand perspective and foreshortening in drawing They merely drew, painted, or carved silhouettes of dance poses The flatness and stiffness were a matter of artistic convention, not a part of the dancing itself

Priests performed some ritual dances without spectators One of these was a "dance of stars" An altar represented the sun The dancers, turning rhythmically from east to west around it represented the constellations, the signs of the zodiac and the planets and symbolized the harmony of the universe Apis, the sacred black bull with snow-white forehead inspired religious processions in which the people took part Worship of Isis and Osiris was the source of many sacred dances Dances were performed during funerals to drive away evil spirits They were painted on the walls of tombs to entertain the soul of the person who had died

Clapping hands, snapping fingers or knocking clappers was the first accompaniment Later, musical instruments were used, including some that were similar to the guitar, tambourine, lyre, flute, harp, and cymbals Dancers often wore bells on their fingers

Although ancient Egypt had no theaters, it had theatrical dancing In wealthy homes slaves danced for the entertainment of the master and his guests During religious festivals and celebrations temple and privately owned slaves with special talent as dancers, acrobats, and mimes entertained passing crowds in the public squares of villages and towns

Some historians of the dance believe that many steps in the modern ballet, such as the pirouette, entrechat, ara-

ART IN THE ANCIENT CIVILIZATION OF EGYPT

These two pictures are from a mural in the tomb of the pharaoh Ante foker and his wife, Senet at Thebes Three women are seen clapping in time with their hands while four girls dance The apparent stiffness is due to the manner of drawing not to the style of dancing

FLOWING MOVEMENT PORTRAYED IN GREEK ART

This sculptured relief from ancient Greece is in the Uffizi Gallery in Florence, Italy. The poses of the dancers and their floating draperies suggest that the dancing of Greece was natural and graceful. Such works of art as this inspired the American dancer Isadora Duncan.

besque and jeté, may have originated in the dancing of the ancient Egyptians.

Dancing of the Classic Age in Greece

The writers of ancient Greece often commented on the dance. Aristotle invented a favorite definition—"imitation of character, emotion, and action by rhythmic movement." But all knowledge of the steps and movements in Greek dance has come from frescoes, reliefs, and vase paintings. These suggest a natural, flowing, expressive form of movement.

Festival dances were a development of all the kinds of dancing natural to primitive peoples. There were rites in the spring to insure fertility in crops and animals. Fall festivals celebrated the harvest. Especially arranged dances commemorated great events. Various gods had their special cults which involved dancing. In Sparta, men danced in armor to increase their agility in war.

Greek drama was born at the festival of Dionysus in the 6th century B.C. (*see* Drama; Theater). The plays always had a chorus, whose spoken words assisted and commented upon the action of the play. The chorus also danced. Though the setting was a theater, the dancing of tragedy was really ethnologic rather than theatrical. Greek tragedy expressed the highest religious concepts of the people; it was not mere entertainment. The dancing of the chorus is thought to have been processional in type, accompanied by rhythmic movements of the body, especially the hands and arms. The dances of comedy, on the contrary, were done for entertainment. They were satirical and lively. Many would probably seem vulgar to modern eyes.

Rituals in Ancient Rome

Ancient Rome borrowed most of its dancing, first from the Etruscans and later from the Greeks. There were a few native ritualistic dances, however. Those of the *salii*, or dancing priests, were performed by young men of patrician families. They marched through the streets in battle dress, each carrying a sacred shield on the left arm and a staff in the right hand. At altars and temples they danced a war dance, beating their shields with their staffs and chanting a hymn. The *lupercalia*, a fertility dance, honored Faunus (Pan). Half-clothed young men danced through the streets swinging whips made from the skins of goats and striking all who came their way. The blows were believed to be a charm against childlessness and the ravages of old age.

Under the Roman Empire the country people continued to dance at festivals in honor of the gods. The upper-class Roman citizens did not dance themselves but demanded professional dancing as entertainment. Theatrical dances became popular—in the streets for voluntary offerings, in the circus and the arena, and at private parties. Professional dancers were found among the Greek slaves in Rome and were also imported from foreign places, chiefly Spain.

The circuses and arenas were huge. The dancer was so far away from most of his audience that he had to make his gestures and movements very clear if they were to be understood. Exact pantomiming was necessary. It represented everything in the life of the ancient Roman: war, religion, poetry, tragedy, comedy, and even the most subtle and personal emotions.

Under Nero and his successors dancing became degraded and licentious and was generally frowned upon. Not until more than a thousand years later did theatrical dance return to favor.

Dancing in the Early Christian Church

The Roman Christian church helped to keep dancing alive by using it as part of the ritual of worship. The theory is that the Church Fathers sensed the people's need for dancing, which had been an essential element in pagan religious services, and made it a part of Christian ceremonials. It was very staid, but still it was dancing. The mass took on a kind of rhythmic pattern accompanied by music and song, and mystical dances were performed.

In the 7th century church dances were forbidden, but they lingered in places for a long time. It is said that in the cathedrals of Seville and Toledo, Spain, there were religious dances as late as the early 1930's.

Dance in the Middle Ages

ALTHOUGH the Roman Christian church did much to insure the survival of dancing in Europe it was not the only agent People clung to the remnants of their ancient rituals One of these was the Maypole dance an ancient fertility dance Another was the carole (forerunner of our modern carols) a round or circular dance usually accompanied by singing Folk dancing flourished in the Middle Ages and court dancing appeared

Wandering troubadours jongleurs and minstrels developed the spectacular dance No theater was provided for them and the church disapproved of them but they kept adding to and improving their entertainment They would stop and perform wherever they could find an audience—in castles on highroads in taverns in streets and market places The dancing men and women with the troupes were called gleemen and gleemaidens They became extremely clever Some could dance on their hands as well as on their feet However they had to compete with acrobats and performing animals Their audiences did not appreciate fine pantomime which thus became a lost art

During the Middle Ages the entertainment within the church gradually included mystery miracle and morality plays These plays became elaborate with large casts and dramatic scenic effects They had dancing characters such as the Devil Salome or personified vices virtues and follies of human nature At first performances took place before the altar of the church later as the number of characters increased in the transept and nave Eventually the cast and the audience became so large the church could not accommodate them The players began performing on the broad front steps and the audiences made themselves comfortable in the churchyard

The first players and dancers were the clergy but as the casts grew the common people were given parts Finally the drama passed out of the church into the hands of the people and dancing was again on its way to becoming an approved public entertainment

The 'dance of death' appeared during the Middle Ages A skeleton represented death The dance was performed in church plays (miracle mystery and morality plays) as a feature in public entertainment and at folk festivals

The spectacular tournaments of the Feudal Age are a link in the history of theatrical dancing These were trials at arms with definite rules By the middle of the 15th century *they had become luxurious and beautiful* pageants (*see* Knighthood Middle Ages)

Dance Madness in the Middle Ages

Reports of strange kinds of dance hysteria have come down from the Middle Ages In the 11th and 12th centuries there were occasions after a death or at a Christian festival when people danced in the church yard as though obsessed despite pleas by the priest that they stop This was a *danse macabre* so called from the Arabic word *makâbr* meaning church yards It is thought to have been a *frenzied effort to* communicate with the dead (The dance of death of morality plays is also known as *danse macabre*)

Another type was called St Vitus s dance People danced in groups until they collapsed When they could they got up and danced again The groups gathering new members might move from town to town The hysteria sometimes lasted for months It appeared in the 14th and on through the 17th century Fear of plague the strain of long wars and poverty are thought to have caused the mania

ENTERTAINMENT IN A MEDIEVAL CASTLE

The people of the Middle Ages were as eager for amusement as we are today This woodcut by Albrecht Durer German artist shows a favorite form of entertainment Strolling players and dancers are performing in the castle courtyard while the occupants of the castle look on

Dancing in the Orient

It is difficult for Westerners to understand Oriental dancing, much as they may admire its beauty. Every movement conveys a traditional meaning to members of an Oriental audience. Occidentals see that the movements are graceful and expressive, but they miss the meaning. One characteristic of Oriental dancing, however, is obvious. Movements of the arms, shoulders, and head are more important than footwork. There is a saying that in the Occident dancing is *from the waist down and in the* Orient from the waist up. Men are the chief dancers, but women have taken an important part, especially in modern times.

JAPANESE GRACE AND DIGNITY

This photograph, taken by Soichi Sunami, of New York City, shows Michiko Izeri, a Japanese-American dancer who studied in California and Japan. The dance is called 'Spring Rain'.

Dancing in India

Dr. A. K. Coomaraswamy, an authority on Indian art, classified Indian dances as *nrtta*, rhythmic dancing without narrative theme; *nrtya*, dramatic dancing with narrative or descriptive theme; and *natya*, the equivalent of acting.

Dance forms vary from the north to the south but everywhere the distinctive characteristic is gesture with related body postures and head movements. The use of fingers, hands, and eyes is of first importance. There are almost a thousand hand movements and signs (*hastas*). Numerous little bells are worn about the ankles, and as the feet move the bells mark the rhythm of the dance. Dr. Coomaraswamy wrote: "No dancer ties the bells upon her ankles before dancing without first touching her forehead and eyes with them and repeating a brief prayer." Sometimes the dancers sing. They are accompanied by musical instruments, generally a drum, a stringed instrument, and cymbals, and sometimes by a chorus.

The *nautch* dancing of India is performed by both men and women. It usually has a narrative theme which is expressed by movements of the head, eyes, brows, and hands. It is danced as a religious ritual at shrines (*where the dancers are called devadasis*, or "slaves of god"), at festivals, and at public and private entertainments.

Japanese Dance Drama

Dancing in Japan was a traditional, continuously developed art form until the period of the second World War. Its best-known phases were the *noh* dance, the *kabuki*, and the dancing of geisha girls.

Noh and kabuki are dance dramas in which dancers enact the parts with a combination of pantomime and dance. The noh developed in the imperial court. Its pace is slow and majestic. There are no leaps in which the feet leave the floor, as in Western dancing. One foot is kept flat on the floor most of the time. When a foot is lifted it is bent upward from the ankle, not downward as in toe dancing. Each movement of head, body, arms, and legs has a traditional meaning. The kabuki is a more modern and livelier version of the noh. These two forms of dance drama are the chief ethnologic dances of Japan.

THESE DANCERS BRING INDIA TO AMERICA

Uday Shankar, in the foreground, was once a partner of Anna Pavlova. He formed a Hindu troupe in 1930 and afterward toured the world with it "I dance the life of our gods and our people," he said. Drums played with the hands and a variety of stringed instruments provided the accompaniment.

The geisha dancer of Japan was famous for hundreds of years. Her profession was respected unless she went beyond her rôle as an entertainer and misbehaved. Usually as a child she was sold to a geisha school by her parents. There she learned to talk graciously, smile charmingly, recite poetry, sing and dance, and play the *samisen*. At 14 or 15 she was con-

sidered a trained geisha dancer and began to serve as a waitress and entertainer at banquets, in private dining rooms and in teahouses During the occupation of Japan by the United States after the second World War General MacArthur outlawed the sale of Japanese girls to geisha establishments

Dancing in China

Thousands of years ago, long before the Christian Era dancing was a cultivated art in China Dancers performed magnificent ballets at the Chinese court A cult of gymnastic dancers called Cong Fou taught health and philosophy through dancing Dancing was also an important part of religious expression

The art declined through the ages until now it is little more than stylized rhythmic pantomime with slow beautiful posturing and symbolic movements The few actual steps used are simple The costume is the traditional Chinese dress made of fine fabrics richly embroidered with stars moon mountains trees flowers and dragons Each design has a symbolic meaning

Mei Lan-fang (1893–1943?) the greatest actor and dancer of his day in China, recreated some of the ancient dances especially the religious ones He danced female rôles exclusively, and he danced them with superb grace

Dancing among the American Indians

THE WHITE men who settled in North America found the Indians living at a Stone-Age level of culture As among all primitive people, dancing was a vital part of their lives Magic-religious and tribal ceremonies, in which dancing played a part, dominated their community life There were separate dances for men and for women and others in which men, women, and children took part Special societies owned some of the dances

Each tribe had its characteristic forms, but certain fundamental steps appeared in practically all of them These included flat-heel, flat-foot and sneak steps, a toe heel hop, and stamp A bent-knee position was typical Trots kicks, and side steps gave scope to the footwork Dancing achieved fluidity through flexibility of body postures varying from an upright strut to a deep crouch with head close to the ground

Drums of various sizes beat out the rhythm The great war drum had eight drummers There were smaller hand drums and water drums Various kinds of rattles attached to the dancer or held in his hand helped mark the rhythm Chanting by the drummers might accompany the dancing The steady beat was either accented or unaccented It often changed from slow to fast tempo and to crescendo

Invasion of their homelands by the white men eventually disrupted the Indians' tribal life Moreover

APACHE DANCE AS SEEN BY AN INDIAN ARTIST

This is one part of a mural painted by Allan Houser, Apache painter for the Department of the Interior Building in Washington, D C It catches the spirit of a vigorous round dance of the Apache Indians

while the Indians were still a threat to peace, the conquerors tried to suppress their dancing because of fear that it would foster a warlike spirit The old dances have survived chiefly in the Southwest where the communal life most nearly follows its original pattern The Sioux, who are said to have been the finest dancers and to have had more than 30 different dances now have only one This embodies bits of the old dances The Sioux call it by various names including "grass dance" and "Omaha dance" The Crows of Montana, who had not performed their ritual sun dance since 1874 in 1941 instituted a new sun dance borrowed from the Shoshones (*See also* Indians)

Ballet in the Western World

BALLET IS rooted in the ritual dance of ancient Egypt the chorus of the Greek drama the Roman pantomimes and the miracle and mystery plays of the Middle Ages It has adopted and refined the techniques of street dancing as it appeared in Egypt Rome and elsewhere

Ballet has had many definitions Actually it is a danced story done according to a traditional technique The pattern and movement of the dance are known as *choreography* The designer of the choreography is called a *choreographer*

Ballet as a recognized system of dance originated in the court of France In 1581 Catherine de Medici then the queen mother commissioned a dance spectacle to be performed in honor of the betrothal of her sister, Marguerite of Lorraine Called 'Le Ballet Comique de la Reine', it is usually considered the

first ballet. The theme was the legend of Circe, and the dancers were members of the court.

Other ballets followed. The dancers, except for a few professionals, were attached to the court. The king himself took part. Dancers used the fashionable social dances of the day, including gavottes and minuets. They wore the current dress without regard to the characters they represented. A Greek goddess, for example, might appear in a powdered wig, high heels, and a dress of heavy brocade with a pannier or hoop skirt.

BALLROOM DANCING WAS LIVELY IN 1827

Here we see how the quadrille looked to a French artist, Jean Isabey, in 1827. The European quadrille, which is shown above, is a group ballroom dance popular in the 18th and 19th centuries. The American quadrille is a square dance in which four couples take part.

Louis XIV, absolute monarch of France, danced the rôles of the gods in court ballets and helped to establish dancing as an art. In 1661 he founded the Royal Academy of Dancing. One of his chief collaborators was Jean Baptiste Lully, a court musician and the first composer of ballet music. Another was Pierre Beauchamp, a musician and court dancer, who first listed ballet technique, including the five positions of the feet.

The French court had set a style, and the other courts of Europe followed it. Then, in the last quarter of the 17th century, ballet moved from the royal courts into the theaters. Professionals took over the performance, and anyone could attend who could pay the admission fee.

Before 1681 there were no women ballet dancers on the public stage. Men danced all the feminine rôles. The first notable woman dancer was Marie Anne de Cupis de Camargo, who danced from 1726 to 1751. She introduced vigorous steps, including the entrechat, wore ballet slippers, discarded hoop skirts and corsets, and shortened her skirt to above the ankle. Her rival, Marie Sallé, danced the Galatea of 'Pygmalion' in a thin Grecian robe. She fought unsuccessfully for the use of appropriate costumes.

Jean Georges Noverre (1727–1810), a French choreographer and dancer, popularized the action ballet, or ballet with a plot, and developed pantomime. He abolished heavy dresses and the masks which had been generally worn by dancers in public theaters since ancient Greece.

The center of artistic development in ballet moved from France to Italy during the French Revolution. By this time the important capitals of Europe had theaters where ballet was a regular feature. The great dancers appeared in all these cities.

The Golden Age of Ballet

Ballet flourished in the romantic era of the 19th century, particularly between 1830 and 1850. Women dancers were idealized Sylphs and dryads clad in white, with long tarlatan skirts (*tutus*) and little wings at their shoulders, glided about half-lit stages. Sometimes they even floated above, suspended by wires, as Peter Pan did later. Women dancers learned to leap into the air in jumps so smoothly done they seemed supernatural rather than acrobatic. Toe dancing appeared for the first time as dancers rose to the tips of their toes to express a superhuman quality. The great ballerinas of the day were the Italians Marie Taglioni, Carlotta Grisi, and Fanny Cerito; Fanny Elssler, of Vienna; and Lucille Grahn, of Copenhagen. Men dancers were relatively unimportant.

Ballet stories in the romantic era were fantastic, sometimes violent, always picturesque and imaginative. 'Giselle', created in 1841 to music by Adolphe Adam, is still danced today. It tells the story of a peasant girl, Giselle, who is deceived by a duke, goes mad, and dies. She becomes a *wili*, one of a band of girls who died before marriage and who come out of their graves at night to dance. Compelled by the queen of the wilis, Giselle lures the remorseful duke into a wild dance that ends only when he falls unconscious.

The Ballet in Russia

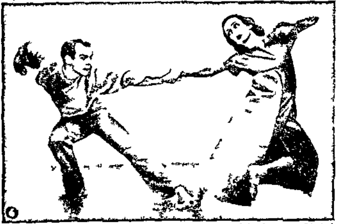
The czarist court had for many years encouraged ballet in Russia. There had been an Imperial School of Ballet at St. Petersburg since 1728. A Frenchman, Marius Petipa, went to St. Petersburg in 1847 as a dancer. He remained to dominate ballet for almost 50 years as choreographer for the Imperial School. With the help of Christian Johannsen, a Dane, and Enrico Cecchetti, an Italian, he made Russian ballet the most celebrated in the world.

Russian ballet, as developed by Petipa, embodied the best features of the French, Italian, and earlier Russian schools. It is the "classical ballet" of today. Technically, it embodies traditional steps, gestures, and stage deportment developed through more than three centuries. At least four ballets from the period are still popular. Three are fairy tales with music by Peter Tschaikovsky: 'Swan Lake', 'The Sleeping Princess', and 'Nutcracker'. The fourth is 'Coppélia', with music by Léo Delibes. It tells the story of a pretty girl who impersonates a doll and pretends to come to life, to the great confusion of the toymaker.

Revolution in Ballet

Ballet in Russia as well as elsewhere had lost its vitality by the end of the 19th century. In most ballets the music was just an accompaniment to supply

THESE DANCERS HAVE ALL BEEN CREATORS



1 This painting of Isadora Duncan by Fritz August von Kaulbach shows her as a young revolutionary of the dance 2 Michel Fokine appears with his wife Vera in the kind of ballet which his break with tradition made possible 3 Ruth St. Denis pictured here in an early Oriental dance *was an inspiring* dancer and teacher 4 Vaslav Nijinsky a legendary figure in ballet is shown here as Petrouchka. 5 One of Ted Shawn's contributions was his interest in American themes 6 Doris Humphrey and Charles Weidman were pioneers in the modern dance movement.

MARTHA GRAHAM'S 'PRIMITIVE MYSTERIES'

The picture above shows one of the earlier group dances created by Martha Graham. A strong and beautiful dancer herself, Martha Graham (in white) composed many dances which expressed basic human experience and emotion.

the right rhythms. As often as not it was a jumble of excerpts from the works of various composers. Choreography had become routine combinations of established steps. Dancing might be technically brilliant but it was not expressive; that is, it communicated little to the mind or emotions of the spectators.

Early in the 20th century a great reformer appeared: Michel Fokine. He had graduated from the Imperial School of Ballet in 1898 and was associated with the imperial Maryinsky Theater. His aim was to revive the expressiveness of dancing while keeping the basic technical facility made possible by ballet training.

Sergei Pavlovich Diaghilev, a wealthy student in St. Petersburg, sympathized with Fokine's ideas. He became a producer, and with Fokine as choreographer and ballet master introduced a revitalized Russian ballet to Paris in 1909 and to London in 1911. His success was enormous. He established a permanent company in 1911. Believing in the union of the arts of painting and music with the dance, he commissioned the finest artists to create scenery and the finest composers to write music. Vaslav Nijinsky, traditionally the greatest of all dancers, was with the company in 1909–13; Anna Pavlova, in 1909 and 1911. Other famous members were Tamara Karsavina, Adolph Bolm, Serge Lifar, Leonide Massine, Alexandra Danilova, Ruth Page, Alicia Markova, and Anton Dolin.

Diaghilev's company toured Europe and South America for almost 20 years. It meant "Russian ballet" to most of the world, though it remained outside Russia. After Diaghilev died, in 1929, no one person had such influence on ballet. (*See* Ballet.)

Development of "Modern Dance"

WHILE BALLET was reforming itself by restoring dramatic expressiveness to its own kind of dancing, an attempt was being made in Europe and America to create an expressive dance freed from traditional steps and movements. Several great creative artists developed the new dance.

Isadora Duncan, an American girl, gave solo recitals in Europe and America. The core of her dance philosophy was communication of emotional experience by natural movement. She felt that "nature must be the source of all art." She saw in Greek dancing the ideal expression of nature, and so she patterned her dance movements after the postures she observed in ancient Greek art. She also found inspiration in the movements of nature—trees swaying in the wind, rhythmic waves, and moving clouds.

Movement could not be free and natural in restrictive clothing, so Isadora danced barelegged and barefooted in a simple Grecian costume. Much of her revolutionary work was done between 1900 and 1908 in Russia and in other countries of Europe. Her first appearance in America in her "new dance" was in New York City in 1908.

Two men who greatly influenced the new dance were François Delsarte (1811–71), a French student of singing, rhetoric, and anatomy, and Émile Jaques-Dalcroze (1865–1950), a Swiss music teacher. Delsarte studied the use and meaning of movement in real life and established a system of gesture. Dalcroze taught a system of free body rhythms, called *eurythmics*, with which to interpret music. Beginning

in 1910 he and his pupils founded schools throughout the world influencing people everywhere who were creating a new dance form

The new dance came to be called *modern dance* because it was different from traditional forms Rudolf von Laban in Germany helped to formulate its theory by experiments in the psychology of movement and the dancer s place in space Among his most famous pupils were the Germans Kurt Jooss and Mary Wigman Hanya Holm also German established a branch of the Wigman school in New York City in 1931 Through her teaching her dancing and her dance compositions she exerted a strong influence on American modern dance

Ruth St Denis an American in 1906 began a dancing career that lasted almost half a century Her early dancing was Oriental and its basic principles free and natural expression and beautiful movement She tried to present honestly the serenity of the Oriental and she was spectacularly successful

TAP DANCING RAY BOLGER

As a tap and soft shoe dancer in musical shows and films Ray Bolger became famous for his loose jointed agility and portrayal of character through the dance

In 1914 Ruth St Denis married Edwin M (Ted) Shawn her partner His credo too was expressive movement In the Denishawn School in Los Angeles they taught Oriental Spanish and American Indian dancing as well as the methods of Dalcroze and the German modern dance Underlying these methods was the conviction that freedom honesty and the most expressive movement were essential

Martha Graham who is perhaps the finest creative artist of the dance in America had her early training at the Denishawn School So did Doris Humphrey and Charles Weidman pioneers who took the modern dance on its first nationwide tour in 1935 Sybil Shearer a fine concert dancer began her career with Humphrey and Weidman

In the modern dance of today every movement means something And the entire body particularly the torso is used not merely the feet legs and arms as in the classic ballet The rhythm of the dance itself is all important Therefore only music that does not detract from the rhythm or emphasis of the pure movement of the dance is used Musical accompaniment serves merely to accent movement

Stage Dance in America IN COLONIAL times most northern colonies condemned the theater on religious grounds The South however welcomed it Williamsburg Va and Charleston S C became theatrical capitals Later Philadelphia New York and other northern cities accepted theatrical entertainment as not interfering with religious belief

Wherever there was theater there was almost certain to be dancing At plays dancers entertained between the acts with theatricalized social dances jigs hornpipes acrobatics rope dances and Pierrot and Harlequin dances A Mr Robertson did an antipodean whirligig in which he stood on his head while spinning around from 60 to 100 times a minute a woman danced with baskets on her feet But dancing was still an incidental form of entertainment

A FAVORITE AMERICAN DANCE TEAM

Here we see Fred Astaire and Ginger Rogers in the motion picture The Barkleys of Broadway Fred Astaire created the dance routines which are original and lively

After the American Revolution dancing became a part of patriotic spectacles Native American dancers began to appear John Durang who danced and sang in a Philadelphia theater in 1785 is said to have been the first Before that dancers had come chiefly from England Ireland France and Italy

All sorts of dancing flourished Shakespearean plays were enlivened by dancing wherever possible Indians performed war dances in the theaters European specialty and ballet dancers were popular Marie Taglioni danced in New York City in 1838 1839 and 1840 Fanny Elssler appeared in 1840 and 1841 In January 1846 Mary Ann Lee and George Washington Smith American dancers introduced Giselle in Boston

BALLET IN MUSICAL COMEDY—'FINIAN'S RAINBOW'

Michael Kidd, American ballet dancer and choreographer, created the dances for this musical comedy. Dancing in musical shows began a climb toward new artistic heights in the 1930's. 'Finian's Rainbow' appeared in 1947.

Augusta Maywood (*La Petite Augusta*), the first American ballet dancer to make a European reputation, appeared in this ballet in New York a month later. 'Giselle' remained popular in the United States for 30 years, until ballet itself lost its appeal.

Early in the 19th century the Negro minstrel appeared, and troupes of minstrels (generally white men with faces blackened by burnt cork) were popular on the American stage for more than 75 years. The banjo, "fiddle," "bone" clappers, accordion, or tambourine marked time for their jig, clog, soft-shoe, buck-and-wing, stair, and pedestal dances.

'The Black Crook', a spectacle produced in 1866, in which there was dancing of high quality, created new standards for musical extravaganzas, burlesque, and vaudeville. In the latter part of the 19th century, the American people saw dancing in the playhouses of large cities, in the "opera houses" of small towns, and in the saloons of frontier communities.

By the early 1900's theatrical dancing was an art in its own right. The top dancers of the world were appearing in American theaters. Loie Fuller thrilled audiences with performances in which she manipulated a fluttering, diaphanous silk costume under changing colored lights to create startling illusions of flowers, rainbows, writhing snakes, and swirling flames. Ruth St Denis and Isadora Duncan had started their revolutionary reforms.

Ballet Gains New Life

Interest in ballet revived in 1908 when Adeline Genée, a Danish ballerina, appeared in New York. Diaghilev brought his Russian ballet to the United States in 1916. Pavlova and her troupe made regular tours between 1910 and 1925 (*see* Pavlova). By 1930 ballet had become a real part of the nation's artistic life. Adolph Bolm and Mikhail Mordkin, former partners of Pavlova, were teaching and dancing here, as was Michel Fokine. Vera Fokina appeared with her husband in various cities during the 1920's.

In 1933 the Ballet Russe de Monte Carlo brought to the United States the best Russian dancers living outside the Soviet Union. Catherine Littlefield founded the first all-American ballet in 1935. It existed until 1942 when its men dancers went into armed service. Lincoln Kirstein set up a small touring group, Ballet Caravan, in 1936. In 1938 it became the American Ballet Caravan; it disbanded in 1941. Ruth Page and Bentley Stone founded a company in Chicago in 1938. Ballet Theatre was organized in New York in 1939; the New York City Ballet, in 1948.

Dancing in Musical Shows

Dancing in musical comedies, vaudeville, and motion pictures has tended to be of the tap or soft-shoe types. In both of these the dancer taps out the rhythm of the dance with his feet. The tap dancer has metal plates on the bottoms of his shoes at the toes or heels or both. The soft-shoe dancer wears shoes with soft soles and no metal plates.

Tap and soft-shoe dancing originated in the clogs, jigs, and hornpipes of Europe and in the clog and shuffle dances of the American Negroes. Among the great exponents have been Fred Stone, David Montgomery, George M. Cohan, Eddie Foy, and Pat Rooney. Bill Robinson, Fred Astaire, Paul Draper, and Ray Bolger have all been true artists in this medium.

A third type of popular stage dancing is line dancing. Its attraction lies in the precision with which many dancers perform the same steps. The Rockettes, of Radio City Music Hall in New York City, exemplify this type.

Modern dance began an invasion of musical comedy in 1932 when Doris Humphrey and Charles Weidman staged dances for 'Americana' George Balanchine started another trend by creating a ballet, 'Slaughter on Tenth Avenue', for 'On Your Toes' in 1936 This trend helped ballet as well as musical comedy

Dancing expanded spectacularly A number of motion pictures had ballet themes and used the finest dancers Other pictures had elaborate sequences in popular dance styles Ice-revue skaters performed ballets on skates Night clubs presented every type of dancing Television provided many new possibilities in the field of dancing

IRENE AND VERNON CASTLE

This couple was a sensation in the United States and Europe in 1912 14 They popularized ballroom dancing

Ballroom Dancing IN THE Middle Ages knights and ladies enlivened their social gatherings by dancing *rounds* These were done in a circle to the accompaniment of singing or hand clapping They had an ancient origin in primitive rituals in which members of a tribe circled about an altar or other symbol Now, however, they were purely social And people everywhere in the Western World have since enjoyed social, or ballroom, dancing

The main development was in France The dancing of the upper classes was called *danse basse* ("low dance") because at first it was slow and dignified and without jumps The aristocracy, however, gradually borrowed steps from the *danse haute* ("high dance") of the common people—the skipping jumping folk dances Among dances which evolved were the pavane, galliard, volta, courante, allemande, gavotte, branle, minuet, cotillion, lancers, waltz, quadrille, polka, galop, schottische, and mazurka (For definitions, *see* Fact-Index)

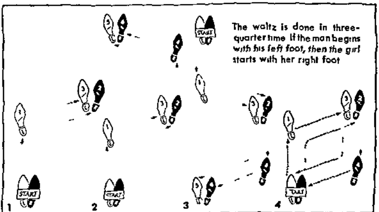
Ballroom dancing in America reflected that in Europe until early in the 20th century. At that time the waltz and the two-step were the only popular social dances Then ragtime music, which had originated among the Southern Negroes, appeared Dances became jerky and fast, less dignified and graceful Popular ones were the turkey trot, bunny hug, and grizzly bear

Vernon and Irene Castle were sensationally popular exhibition ballroom dancers in 1912–14 They refined the early ragtime steps into sophisticated dances, introducing the one-step, Castle walk, fox trot, Castle polka, and hesitation waltz They also popularized the maxixe from Brazil and the tango from Argentina

After the advent of jazz music, about 1914 jazz dancing which was an exaggeration of ragtime rhythms and steps, appeared It reached a peak of popularity in the 1920's Two favorite dances were the Charleston and the black bottom Jitterbug dancing followed, along with swing, or jive, the phase into which jazz music evolved about 1935 Among the first and most popular jitterbug dances were the Lindy hop, the shag, the Suzy Q, and truckin'

South American dances became more and more popular Square dancing, a type of folk dance, became prevalent (*see* Folk Dance) But the waltz and fox trot remained favorites through these changes

HOW THE FEET MOVE IN THE WALTZ



The diagrams above, from the Arthur Murray Studios show how to do the waltz (1) the basic waltz step (2) waltzing forward (3) waltzing backward, (4) the box step To make a left turn, use the box step and turn to the left a quarter on the first and fourth counts. To make a right turn, think of the box step diagram as reversed and turn to the right.

DANDELION. The dandelion is a champion among plants for getting along in the world. Each plant will grow year after year from a deep, fleshy root. The deeply scalloped leaves grow in a low crown near the ground. If the leaves or the flowers are cut, more grow in a few days. The hollow flower stems can grow two or three feet high to reach sunlight. But they hug the ground if a householder keeps the plants cut with a lawn mower. The best way to get rid of dandelions in a lawn is to use a weed killer such as *2,4-D* (*see* Weeds). They may also be pulled, but it is necessary to loosen the plant in the ground so that the whole taproot comes out.

The dandelion also has a splendid way of scattering seed. Each flower has 150 or more little blades (florets) set in a cup. (For a picture in color, *see* Flowers.) Each floret is really a little flower. It has parts for growing and catching pollen, and the lower end produces a seed. When the seed ripens, it pushes up a feathery structure called a pappus, on a thread-like stalk. All the pappi together make up a round "blowball." From this the wind takes the feathered seeds and scatters them far and wide.

We have several uses for this hardy plant. The leaves can be boiled like spinach or eaten raw in salads. In some localities it is grown in beds for sale as food. Roasted roots can be used like coffee. The milky juice (latex) of the plants supplies a little rubber. A Russian dandelion called the *kok-saghyz* gives the best yield.

Dandelions are natives of Europe and Asia; but they have spread through all temperate lands. They belong to the composite family of plants. They bloom throughout the spring and summer. Scientific name of the common dandelion, *Taraxacum officinale*.

DANTE (*dän'tā*) **ALIGHIERI** (1265–1321). Just as the Renaissance or "rebirth" of literature and art started in Italy, the country's greatest poet was born in Florence. His family belonged to the nobility. As with other great men, a halo of legends surrounds his early life, but the essential facts are told in his book called 'Vita Nuova' (New Life). When only nine years old he met the Beatrice of his later poems and formed a passion for her which never cooled and which influenced the whole course of his later life.

Dante's education gave him a mastery of the Latin learning of that day. As a citizen of one of the chief of the little city-republics he played his part in the political and military conflicts which were tearing all Italy to pieces (*see* Guelfs and Ghibellines). He rose to high office in Florence and was sent on an embassy to the Pope at Rome in 1301. When the victory of the more extreme party in Florence (the Black Guelfs) resulted in the banishment of the leaders of the opposite party (the White Guelfs), Dante was included (1302); and later he with others was condemned to be burned alive if caught.

The remainder of the poet's life was spent in bitter exile. He himself says: "Through almost all parts of Italy, a wanderer, well nigh a beggar, I have traveled, showing against my will the wounds of fortune." His sympathies now were entirely with the Ghibelline party, and he looked—though in vain—to the Emperor in Germany as the source from which unity and order should come to cure the anarchy of Italy. He died in 1321, in Ravenna, a beautiful old Italian city situated among the lagoons of the Adriatic some distance south of where the River Po enters that eastern sea.

There in a marble urn still reposes the poet's bodily remains, beneath a tomb which the poet Byron called "a little cupola more neat than solemn." The portrait by his Florentine friend Giotto preserves his features for us as they were before the cares and sorrows of exile had left their marks upon him. But his true monument, known and loved by poets, artists, and scholars everywhere, is his immortal poem, the 'Divine Comedy'.

No work except the Bible and Shakespeare's plays has given rise to so much literature. It was copied in 600 manuscripts before the invention of printing, and about 300 printed editions have been issued. It has been translated into foreign languages more than 300 times; and unnumbered introductions, essays, and commentaries have been written on or about it. Dante had not been dead 20 years before Italy recognized that he had been its greatest man. About 50 years after Dante's death a public lectureship on the 'Divine Comedy' was established at Florence. The first appointee to this chair was Giovanni Boccaccio. It was a fitting choice, for Boccaccio was the founder of Italian prose, as Dante had been of Italian poetry.

DANTE AND HIS HOPELESS LOVE FOR BEATRICE

At the Ponte Santa Trinità in Florence, Dante tries to win a glance from Beatrice (with flower). This painting, 'Dante and Beatrice' is the work of Henry Holiday.

The 'Divine Comedy' is a descriptive narrative of an imaginary journey through Hell (*Inferno*), Purgatory (*Purgatorio*), and Heaven (*Paradiso*) The action begins on Good Friday of the year 1300 and ends on the Sunday after Easter The poet pictures himself journeying these ten days down through the abyss of Hell, up the mount of Purgatory, and on up through all but the highest circles of Heaven The Roman poet Vergil serves as his guide in Hell and Purgatory, the "divine Beatrice" in Heaven The book is crowded with hundreds of persons whom Dante meets along the way Some are imaginary symbolic figures, but most of them are actual historic persons from the distant past and from the poet's own time

In its wealth of imagery and in the power of its language, the poem has never been surpassed It is written in *terza rima* consisting of stanzas of three lines rhyming ABA, BCB CDC, and so on In Dante's hands the verse has a noble and sustained effect It is a difficult form, however and has been little used since his time

DANTON (*dan-tôn'*), GEORGES JACQUES (1759–1794) "I am Danton, sufficiently known in the Revolution I shall soon pass to nothingness, but my name will live in the Pantheon of history" This was the reply of the great leader of the French Revolution when asked his name by the court which condemned him to death

For two years, 1792–94, he had been guiding and controlling the destinies of France When the country was threatened by outside foes, he aroused his countrymen by his famous cry "We must dare, and again dare, and dare without end" And inspired by this challenge they drove the Austrian invader from their soil Along with Marat and Camille Desmoulins Danton had founded the Cordeliers Club which soon became the rallying point of all the hotter revolutionists

The man who thus became the leader of the people of Paris had not an attractive appearance His face was pitted with smallpox, and he described himself as having "the athletic shape and the stern visage of the Liberty for which he was ready to die"

An able and eloquent lawyer, he was inspired by an ardent patriotism which he managed to communicate to others Although an extreme republican, he was anxious to keep all Frenchmen working together for the good of the country When the aristocrats and *émigrés* (emigrant nobles) persisted in opposing the cause to which he devoted his life, he with Marat and Robespierre inaugurated the Reign of Terror, which was carried out by the Revolutionary Tribunal

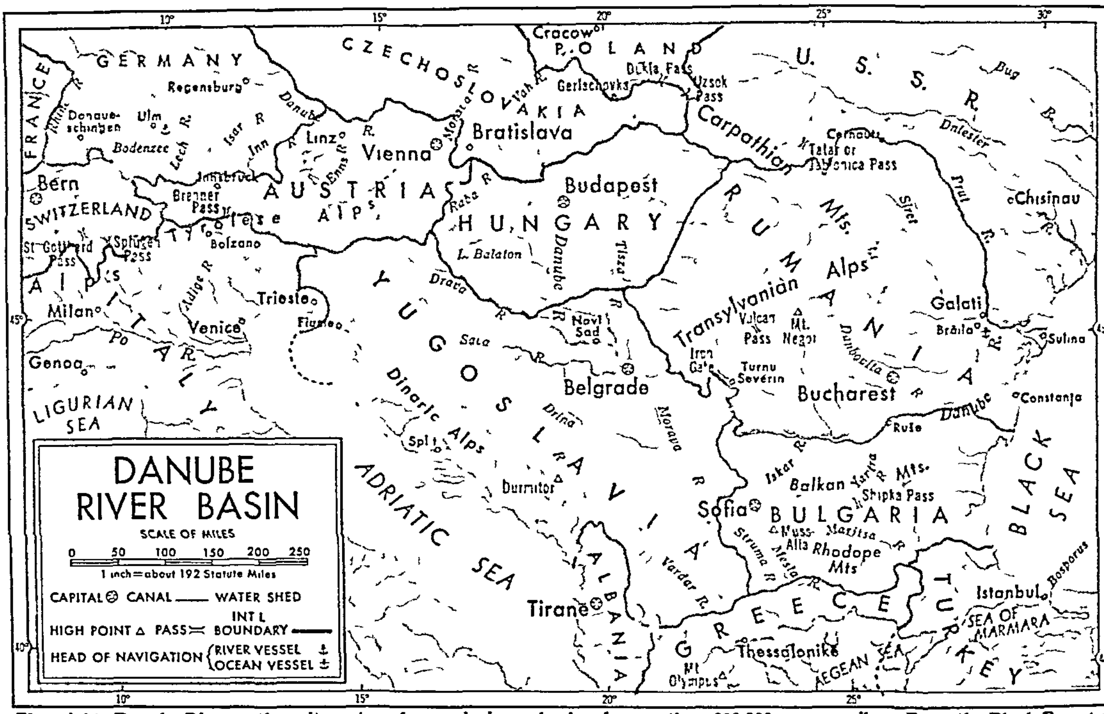
When invasion was repelled and royalist uprisings put down, Danton was the first to advocate that the system of Terror be abolished The need for it was then past, in his opinion His associate Robespierre, unwilling to sacrifice any of his power for the good of the country, decided that Danton should be brought before the Revolutionary Tribunal and condemned to death St Just, a member of the Committee of Public Safety, denounced Danton, and because of the inflamed passions of the time, the great leader's doom was certain.

A friend of Danton's urged him to resist arrest, but he replied 'That means the shedding of blood, and I am sick of it. I would rather be guillotined than guillotine" When urged to flee, he said "Whither flee? You do not carry your country on the sole of your shoe" Before he was executed he declared, "A year ago I proposed the establishment of the Revolutionary Tribunal I ask pardon for it, of God and man" His fame remains secure as one of the ablest as well as noblest of the iron leaders of the Revolution which overthrew the old monarchy in France

DANUBE (*dăn'ūb*) **RIVER.** In a pleasant little valley of the Black Forest—a northern spur of the Alps—a tiny stream comes tumbling down the rocks and, gathering volume and strength from many springs and rivulets, cuts a channel across the sunny slopes and spreading hayfields of south Germany This little stream, the Brege, with its twin sister, the Brigach, is the source of the Danube, the greatest river of Europe next to the Volga The Danube has been since earliest history a great water highway, connecting and dividing varied and interesting nationalities, gathering the waters of more than 300 tributaries, and draining one-tenth of Europe in its course of 1 750 miles from the southwest corner of Germany to the Black Sea A canal 108 miles long binds it to its sister river the Rhine by connecting its tributary the Altmuhl with the River Main So close are the headwaters of the Danube, draining to the Black Sea to the course of the Rhine, running to the North Sea, that it is often said that the deflection caused by a single pebble might determine the destiny of a raindrop falling on the dividing highlands

Once a Roman frontier, the Danube through passing centuries has been in turn the highway of westward moving Huns, Slavs, and Magyars, a barrier and a goal for Russian, Austrian, German, Bulgarian, Turkish, and Rumanian armies, and the channel of eastward- and southward flowing German culture and influence Great states, great men, and great cities have flourished on its banks, and the Danube alone remains unchanging and untroubled

In its course across southern Germany it is not yet the "beautiful blue Danube" of song, but a rushing stream hurrying along among wooded hills and fertile meadows, past picturesque Bavarian towns At Ratisbon (now called Regensburg) its northernmost point, the Danube is alive with towboats, barges, and rafts busied with the commerce of grain growing Bavaria Soon the Bohemian hills edge down the river and deflect its course southeast to Vienna. Then a journey of 30 miles brings one to Bratislava and the edge of the rich plain (Alfold) of Hungary, checkered with growing crops In fertile valleys white-walled villages shimmer in the sunlight among yellow fields of ripening grain One now hears the musical Magyar tongue, and sees a new type of face, suggest-



The mighty Danube River gathers its waters from a drainage basin of more than 320,000 square miles. From the Black Forest of southern Germany to the Black Sea its course lies through the lofty Alps and southward across the broad Hungarian plains. After dashing through the narrow Iron Gate it flows over the low marshlands of southern Rumania to the sea.

ing a warmer sun, a longer summer, and habitual out-of-door life. After passing through Bratislava, the Danube flows almost 100 miles east into Hungary. Then the river makes a great bend and begins its 500-mile journey into the south.

At Budapest imposing bridges span the Danube's course. Below the city laughing groups of women stand knee-deep in its shallows beating clothes with wooden mallets. Tree-embowered villages nestle long distances apart at the foot of vineyard-clad slopes. Occasionally one passes a group of fishermen's huts and miles of nets drying in the sun. Canals contribute their burden of huge cargoes of grain and lumber from the Hungarian plains. After passing the junction of the eastward-flowing Drava and Sava and the great southward-flowing Tisza (or Theiss) with the Danube, one comes to fateful Belgrade, Yugoslavia's capital. Here the mighty river, again heading east, spreads out like a wide lake, with the little white homesteads of the Serbian peasants dotting its shores.

The Kazan Narrows and the "Iron Gate"

A hundred miles farther on one comes to the black beetling cliffs of the Kazan defile, where the Danube narrows to 160 yards and there is almost twilight gloom. A long gash in the face of the almost perpendicular rock walls tells of the road Trajan's warriors built on the way to found the colony of Dacia, Rumania's ancestor. Just below, the river gathers all its force and batters its way between the Balkan and Carpathian ranges through the historic gorge known as the "Iron Gate" of Orsova. The commercial importance of the Danube necessitated the blasting of a channel here, deep enough to allow river steamers to pass the mile and a half of rapids at all seasons.

As though exhausted by the storming of the Iron Gate, the Danube from Orsova on winds sleepily through a peaceful countryside, separating Rumania from Bulgaria—its monotony broken only by an occasional fishing hamlet or straggling half-Turk, half-Bulgarian, or half-Rumanian town. Beyond Silistria the river turns abruptly to the north, with the swampy Dobruja on the east all the way to the important ports of Braila and Galati. Here, 125 miles from the mouth, is the head of navigation for seagoing vessels, and so these cities are the shipping centers for agricultural Rumania and other Danubian regions, with docks and grain elevators. Forty-five miles below Galati, the river divides into three arms which wander across the flat, swampy delta.

What the Danube Means to Europe's Commerce

The Danube not only serves as a channel for local trade among the nations along its banks, but it is also the main route by which the cereals, ores, and oil of southeastern Europe are exchanged for the manufactures. The right to enjoy free commerce on the river is vital to every Danube Valley nation. Europe recognized this in the Peace of Paris (1856), which declared Danube navigation free to all nations. Two international commissions governed the river. In 1938-40 Germany won control. After the second World War the Allies agreed to internationalize the river, but Russia's satellite nations got control.

DANZIG (*dăn tsĭg*) Built on the Vistula River, about three miles from the Baltic Sea Danz g became a trading center as early as Roman times Through it later passed the commerce of Poland Lithuania and Germany, making it one of the Balt c s ch ef ports

In the 13th century the Dukes of Pomerania made Danz g their capital The Teutonic Knights seized it in 1310 Under their tyrannical rule it became a wealthy member of the Hanseatic League (*see* Hanseatic League) In 1466 Danzig was ceded to Poland When Poland was partitioned 1793 96 Danz g went to Pruss a Except for about seven years during the Napoleonic Wars when it was declared a Free State it remained German t ll after the first World War

To give the revived nation of Poland a seaport the Treaty of Versailles in 1919 made Danz g a Free City protected by the League of Nations With the buffer zone allotted to it the Free City (called Gdansk by the Poles) covered 754 square m les It was hoped that its semi independence would prevent Germany and Poland from quarreling over it in the future

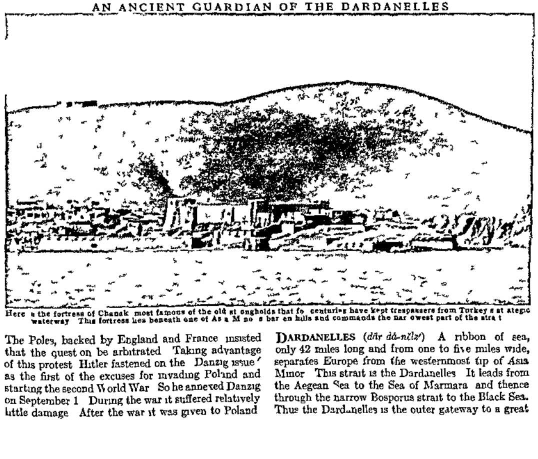
But nine tenths of Danzig s 410 000 inhabitants were of German blood and Hitler s r se to power in Germany in 1933 launched a strong Nazi movement in the Free City In 1939 th s Nazi group supported Hitler s demand for the return of Danzig to Germany

The Poles, backed by England and France insisted that the quest on be arbitrated Taking advantage of this protest Hitler fastened on the Danzig issue as the first of the excuses for invading Poland and starting the second World War So he annexed Danzig on September 1 During the war it suffered relatively little damage After the war it was given to Poland (*See also* World War Second) Modern Danzig has retained its medieval appearance Through the years new structures were built to resemble the high steep-roofed dwellings and gu ld halls of br ck and stone r chly decorated with wrought iron brass and sculptured figures The Artushof (Arthur s Court) bu lt by merchant princes as a clubhouse was preserved to serve as a grain exchange The spires of St Mary s Church a great Gothic cathedral begun in 1343 soar above the c ty Toward the outsk rts arose industrial areas and a Baltic seaport Populat on of Danzig (1950 registration) 191 001 of Gdynia 117 702

DAPHNE (*dăf nĭ*) One of the beautiful legends of Greek mythology tells of the nymph Daphne whom Apollo loved When he descended to earth to woo her she fled from him and prayed to her mother Gaea the earth goddess to save her Through the intercession of Gaea Zeus turned Daphne into a laurel tree From that t me Apollo made the laurel his favorite tree and its leaves were sacred to him. Winners in the Pythian games as well as great poets, were honored with a crown of laurel

Poss bly because Daphne s father was a river god her name mod fied to *Daphnia* has been applied to a genus of m nute crustaceans common in ponds and streams These creatures also cal ed water fleas have b rdlike heads branched antennae and transparent b valve shells

AN ANCIENT GUARDIAN OF THE DARDANELLES



Here s the fortress of Chanak most famous of the old st ongholds that fo centuries have kept trespassers from Turkey s st ategic waterway This fortress lies beneath one of As a M no s bar en hills and commands the nar owest part of the stra t

DARDANELLES (*där dă-nĕlz'*) A ribbon of sea, only 42 miles long and from one to five miles wide, separates Europe from the westernmost tip of Asia Minor This strait is the Dardanelles It leads from the Aegean Sea to the Sea of Marmara and thence through the narrow Bosporus strait to the Black Sea. Thus the Dardanelles is the outer gateway to a great

productive area. The world's ships must pass through here to reach the grain ports of the Ukraine and the oil ports of Rumania and the Caucasus region. The western or European side of the strait is formed by the Gallipoli peninsula.

The strait is rich with history and legend. In ancient times it was called Hellespont (Helle's Sea) in memory of Helle, mythical Boetian princess. She was drowned in its swift waters after falling from the back of the ram with the golden fleece. Across the Hellespont from the eastern side, Leander swam nightly to visit his beloved Hero, priestess of Aphrodite. In 480 B.C. Persia's king Xerxes sent his army across the strait on a bridge of boats to invade Greece. In 334 B C. Alexander the Great similarly crossed from Greece to invade Persia. The strait takes its name from the old town of Dardanus.

The Dardanelles passed into Turkey's control in 1453. In later years Turkish control was supported by British diplomacy, which sought to bar Russia from the Mediterranean. But in the first World War Turkey was allied with Germany. The British wanting to get aid to Russia through the Black Sea, tried to capture the Gallipoli peninsula in 1915–16. They were thrown back and the Dardanelles remained unconquered (*see* World War, First).

After Turkey's defeat in 1917 the Dardanelles became part of a neutral "zone of straits," under the League of Nations. But in 1923 the Treaty of Lausanne restored the region to Turkey. At first Turkey was denied the right to fortify the straits, but this right was restored by a treaty signed in Montreux, Switzerland, in 1936. This treaty also permitted Turkey to close the straits to belligerent ships in wartime.

Since Turkey was neutral until the last days of the second World War, the Montreux treaty kept the Dardanelles route to Russia closed to the Allies (*see* World War, Second). With this sea route barred, the Allies were forced to build roads through Iran to get supplies to Russia. Russia was then determined to get part control of the Dardanelles after the war. In 1946 Russia made formal demands on Turkey for a share in the control, but Turkey refused and again refused in 1947. As the threat of Russian aggression in Europe increased, the United States and Britain encouraged Turkey to stand firm on sole control. Turkey did, again refusing Russia in 1950.

DARIUS I (550–486 B.C.). One of the most powerful monarchs of ancient times was Darius the Great. He ruled over the vast Persian Empire that ranged from the Aegean Sea on the west to the Indus River on the east, encompassing a territory nearly the size of the present United States.

Darius was born in the reign of the great conqueror, King Cyrus I. His father was Hystaspes, a *satrap* (governor of a satrapy, or province) under Cyrus, and a distant relative of the king. Darius grew up at the court. When Cyrus' son and successor, Cambyses I, died, the throne was seized by a pretended heir, Gaumata. With the help of six Persian nobles, Darius assassinated the pretender and established himself as king.

The sudden change of rulers encouraged many vassal states to rebel. Darius spent six years putting down the revolt. To maintain control, he devised a strong uniform system of government (*see* Persian History). He fixed tax rates, set up a standard coinage, and wrote a code of laws. He declared, "... I love justice, I hate iniquity. It is not my pleasure that the lower suffer injustice because of the higher."

To encourage trade, Darius dredged the old Egyptian canal connecting the Nile and the Red Sea. He built roads and set up post houses to aid travelers. Under him, slaves completed building the magnificent palaces at Susa and Persepolis. To extend the empire, Darius' generals conquered Thrace and Macedonia in the west and the Punjab and much of the Indus Valley in the east. Libya became a satrapy in 512 B.C. Five years later Darius made an alliance with Athens; but this was short-lived. About 500 B.C. the Ionian Greeks revolted from Persian rule (*see* Persian Wars).

For 14 years Darius waged intermittent war with the Greeks. In 486 B.C., while preparing a campaign against the Egyptians, he fell ill and died. His tomb was built into a cliff near Persepolis. He left a record of his reign chiseled on the side of a rocky cliff overlooking the village of Behistun, in Iran.

How DARWIN *Answered* NATURE'S RIDDLE

DARWIN, CHARLES ROBERT (1809–1882). The man who became England's greatest biologist was born on Feb. 12, 1809, the birthday of Abraham Lincoln. Darwin's father was a successful and wealthy physician; his mother was a daughter of Josiah Wedgwood, the famous British potter. She died when Charles was eight years old; and the boy was reared by three older sisters, who constantly found fault with him.

At school in his home town of Shrewsbury, young Charles was a rather poor student. He cared nothing for classical languages and ancient history. He liked best to collect shells, birds' eggs, and coins. He also watched birds and insects and helped his brother make chemical experiments at home. These activities, he said in later years, were the best part of his education.

At the age of 16, Darwin began to study medicine at the University of Edinburgh. Here too he found the courses dull, and watching operations made him ill. In 1828 he transferred to Cambridge, intending to become a clergyman. Instead, he devoted most of his time to studying plants and animals and later to geology. He received his bachelor's degree in 1831.

Then came the event that shaped his life—an appointment as unpaid naturalist on the exploring ship *Beagle*. It left England on Dec. 27, 1831, to make astronomical observations, chart the southern coasts of South America, and sail around the world. The

voyage, with many side trips on land, lasted until October 1836 During those five years Darwin examined geologic formations, collected fossils, and studied plants and animals He also began to doubt that the many species of living things had come into being at one moment In 1837, soon after returning to England, he began to collect information on the subject we now call evolution (*see* Evolution)

Early Ideas of Evolution

Evolution was not a new idea even in Darwin's day Long before the time of Christ philosophers had explained the great variety of plants and animals by proposing "natural" ways they could have developed Before 1600, Sir Walter Raleigh concluded that dogs had turned into wolves and that the different races of men were related Several philosophers also declared that new conditions caused plants to change into new varieties or species

CHARLES DARWIN AS A YOUNG MAN

This drawing of the famous biologist was made about 15 years before he published The Origin of Species

Comte de Buffon (1707–88) went still further In his 36-volume 'Natural History', he declared that modern animals had evolved, or "degenerated," from others, and so on back to the beginning Some changes he thought, were produced when different forms interbred others were caused by food climate pressure, and so on According to Buffon's theory, the hippopotamus and elephant are large because their ancestors ate a great deal of food, the hair of lions is tawny because it has been bleached by the brilliant sunlight of the tropical plains

The Chevalier de Lamarck (1744–1829) maintained that plants and animals evolved because of an inborn tendency to progress from simple to complex forms Environment, however modified this progression and so did use or disuse of parts Giraffes for example, developed long necks by straining to reach the leaves of trees, snakes lost their legs by crawling Birds, said Lamarck came from hairy ancestors Their attempts to fly forced air into the hairs and so turned them into feathers

Darwin knew about these attempts to explain evolution, for his grandfather Erasmus Darwin had published several books containing ideas much like Lamarck's theory of use and disuse But he felt that all early writers on the subject had indulged in too much speculation and had collected too few facts As a result, they failed to convince the scientific world that evolution had actually taken place They also failed to give a reasonable explanation of how changes might have produced the different organisms found upon the earth today

Darwin Attacks the Great Problem

Darwin determined to avoid these mistakes, and to collect and test facts scientifically *before explaining* them After his return to England he followed this course for 15 months, meanwhile also writing up the 'Journal' of his scientific work on the Beagle

Then he happened to read 'An Essay on the Principle of Population by a British economist Thomas Malthus Malthus undertook to prove that human populations tend to increase more rapidly than food and other necessities The result is a struggle in which some people succeed and become wealthy while others fail or even starve

Darwin applied this theory to the world of nature Plants and animals he knew reproduce so rapidly that the earth could not hold them if all their young survived This meant that there was a constant struggle for space, food and shelter, as well as against enemies and unfavorable conditions Young trees for example struggle for space those that grow most rapidly survive while those that grow slowly become stunted and die Certain hawks struggle or compete with each other for the mice they eat and the poorest hunters go hungry Mice in turn, struggle to keep from being caught by hawks During frigid winters all living things struggle against cold Some endure it and others keep themselves warm but many die because they can do neither

Struggling and living or dying could not lead to evolution if all members of each living kind or species were exactly *alike* *But Darwin found that members* of a single species vary greatly in shape size, color, strength and so on And he also believed that most of these variations could be *inherited*, or passed on from parents to offspring (*see* Heredity)

Under the constant struggle to exist, organisms with harmful variations were almost sure to die before they could have young ones But living things *with useful variations survived and reproduced* When descendants of these survivors varied still more, the process was repeated In other words, the struggle for existence *selected* organisms with helpful variations but made others die out This was the critical point in Darwin's reasoning

This *natural selection* had two further effects that were important Many newly developed organisms

remained in their old homes, where they struggled successfully against older forms, crowding them out of existence. Other new organisms made their way into different surroundings, where they prospered and kept on changing. During the ages, these two factors produced a steady succession of new plants, animals, and other organisms. They enabled living things to go into all sorts of environments and become fitted, or adapted, to many different types of life. Thus mammals, which started out on dry land, also spread into swamps, lakes, and seas. Some climbed trees, some burrowed, and some even became able to fly.

Darwin wrote a short sketch of his theory in 1842 and a longer one in 1844. Instead of publishing the second statement, however, he continued to collect information. He also took time to write books on coral reefs, volcanic islands, barnacles, and the geology of South America. Not till 1856 did he begin what would have been a three- or four-volume book on the subject of evolution.

In 1858 he received a manuscript from a young naturalist, Alfred Russel Wallace, who also had developed a theory of natural selection. Although Darwin was willing to withdraw in favor of Wallace, his friends insisted that he publish his own discoveries without further delay. With Wallace's approval, short statements by both men were published late in 1858. The scrupulous fairness of the two men prevented any rivalry between them, and they became good friends.

Darwin went on to write his famous book 'On the Origin of Species by Means of Natural Selection', which appeared in 1859. In it he presented detailed evidence to prove that evolution had taken place and showed how natural selection might have brought it about. Darwin also suggested that certain animals had developed antlers, handsome colors, and so on, because mates with those characters were chosen by the opposite sex. This theory of *sexual selection*, however, was incidental to the larger one of natural selection, which is properly termed Darwinism.

Darwin married a cousin, Emma Wedgwood, in 1839. Three years later the couple moved to a quiet country home at Down in Kent, southeast of London. There he spent the remainder of his life. Mrs. Darwin protected her husband from all possible annoyance and confusion, since both made him ill.

After completing the 'Origin of Species', Darwin began 'The Variation of Animals and Plants under Domestication', which showed how rapidly some organisms had evolved under artificial instead of natural selection. 'The Descent of Man', published in 1871, elaborated the theory of sexual selection and applied Lamarck's unsound theory of use and disuse. Later books dealt with earthworms, orchids, climbing plants, and plants that eat insects. 'The Power of Movement in Plants' was written with the help of Darwin's son, who became a botanist. Another son was an astronomer and two were noted engineers.

Charles Darwin was lacking in brilliance of any showy sort. He once listed his deficiencies—slowness of apprehension, limited ability to follow a long and abstract train of reasoning, hazy memory, and awkwardness in expressing himself. But he had, nonetheless, one of the keenest minds of his age. His interests were wide, and he made contributions of the first importance in many fields. His most noteworthy quality, perhaps, was a deep love of science. To this he coupled a fierce, dogged persistence in tracking down facts. He cared little for personal fame; this was partly the reason why he never replied to attacks on his work.

Darwin became very weak in 1881 and complained that he no longer could work. He died on April 19, 1882, and was buried among England's greatest men in Westminster Abbey.

DATE PALM. Four thousand years ago this valuable tree was grown and cultivated along the Euphrates and Tigris rivers. Where it was too hot and too dry for other plants to grow, the date palm flourished, and during all these centuries it has blessed the natives with its fruit, its timber, and its cooling shade, under which they live. Many desert parts of Arabia and the Sahara would not be habitable were it not for this tree which grows in their oases, and which is the most important food plant of the great deserts. Egypt alone has more than 5,000,000 bearing date palms.

Not only is this tree remarkable in its power to resist heat and drought, but it can also withstand greater quantities of alkali in the soil than any other useful fruit tree. This has been a vital factor in the development of a date-growing industry in regions of the southwestern United States where the soil is too alkaline to support any ordinary crop. Dates are now being grown successfully in several hot irrigated valleys of California and Arizona, notably in the Imperial Valley of the Salton Basin, in the Coachella Valley (just north of the Imperial Valley), and in the Colorado, Gila, and Salt river valleys of Arizona. Other countries where the date is successfully cultivated are China, Italy, France, and Spain.

How the Date Palm Grows

The date palm may attain a height of 100 feet. It has a straight rough trunk which bears its large cluster of leaves and fruit at the top. The leaves are feather-shaped, 12 to 18 feet long, and from 12 to 20 leaves are produced each year. These remain alive and green for several years but finally lose their color and bend downward toward the trunk, where they are retained in very arid regions. In other regions the leaves finally break off, leaving the trunk rough.

Date palms are divided into male trees bearing staminate blossoms and female trees bearing pistillate blossoms (*see* Flowers). Where they grow in a wild state, the wind must carry the pollen from the male to the female, but, in cultivation, sprays of male blossoms are tied to the female flower clusters.

Each pistillate flower cluster produces a bunch of dates weighing from 10 to 40 pounds, and a vigorous tree is allowed to produce from 8 to 12 such bunches. The tree is grown usually from shoots and begins to bear within four to eight years. It continues to bear until a century or more old, producing from 60 to 600

A YOUNG ARIZONA DATE ORCHARD

Heavy w th fruit the stems of these young trees hang almost to the g ound When the trees reach the r full g owth the cluste s may be from 30 to 40 feet above the g ound and the f u t will have to be p cked f om ladders or f om platforms bu lt around the palms.

pounds of delicious fruit a year Dates are of very l igh food value and are eaten either fresh or dried The trunk and leaves of the tree furni h the Arabs with materials for building hou es and for weaving ropes and mats Scientific name *Pl oenix dact jl fera* (For illu tration in color *see Fru ts*)

David Wherever the stor es of national heroes are told we hear of David who rose from shepherd boy to king of Israel nearly 3 000 years ago He meant so much to his nation that the B ble carefully tells his whole life from boyhood until death *It is a* story mingling sentiment and violence noble achievements and dark guilt

David was the youngest son of Jesse a man of Beth lehem H s mother s name is not recorded While a shepherd he learned to play the harp an l to hurl stones with deadly accuracy from a sling These skills were to change the course of his life

Saul at that time king of Israel called for mu c to quiet his troubl l spirit David came with his harp and he was so hand ome and his music so pleas ing that Saul made him his armor bearer and musician

Then David met Goliath This Phili tine had chal lenged Saul for 40 days to send out a man to fight him B it no one responded for Goliath stood over nine feet tall He brandished a spear that had a 20-pound head of iron and a shaft like a weaver s beam He wore a huge brass helmet and a brass coat of mail that weighed 160 pounds

David went out as if to kill a beast that preyed on his father s flocks He wore *no shining armor only* a shepherd s homespun garment He carried no sword or spear only a sling hidden in his hand and five smooth stones in a bag at his side

As Gol ath came into range David reached into h s bag put a stone in his sling and let go with all his might The stone pierced Goliath s forehead and he fell dead David unsheatl ed Goliath s sword and cut off the giant s head as a present to Saul The Philistine army fled in terror

At that time David became a very good friend of the king s son Jonathan Even today David and *Jonathan* are n cknames for close friends Jonathan gave the humble shepherd boy his royal garments and his sword and his bow Davi l now a full fledged war rior fought so bravely against tl e Philist nes that the women of Israel said Saul hath slain his *thousands* and David his *ten thousands* (I Sam xviii 7)

Saul begar to fear that the people wo ild make David king So he tried again and again to kill him He

even tried to kill his own son Jonathan for shielding David. Jonathan, however, helped David to escape. Saul's army followed and David had to hide. Twice David could have killed Saul, but he preferred being chosen king to seizing the throne by murder.

In the battle of Gilboa both Saul and Jonathan were killed. With Saul gone, David ruled at Hebron as king of Judah for seven and one-half years. When the king of Israel was murdered, the Israelites anointed David as their king about 1000 B.C.

David ruled Judah and Israel as a united nation until he died 33 years later. He moved from Hebron to Jerusalem, which his nephew Joab had captured for him. Joab also conquered Israel's neighbors until the nation's power reached even into Syria.

Years of bloodshed and famine followed. David in his palace sang of his earlier triumphs and lamented his sufferings. The treason and death of his favorite son, Absalom, filled him with grief. David's worst crime was his betrayal of his faithful captain Uriah, so that he might marry Uriah's wife, Bathsheba (II Sam. xi). Just before the old king died he named men whom his son Solomon was to kill. Included was the faithful Joab himself (I Kings ii).

DAVIS—PRESIDENT *of the* CONFEDERATE STATES

DAVIS, JEFFERSON (1808–1889). During the Civil War, Jefferson Davis was president of the Confederate States and Abraham Lincoln led the United States. Both were born in Kentucky, several months apart, Davis on June 3, 1808. The Lincolns moved to Indiana soon after, then to Illinois, while the Davises moved to a small plantation in Mississippi.

Jefferson was the tenth child of Samuel Davis, a planter. Jefferson's father was not wealthy, but the oldest son, Joseph, became well-to-do and helped the boy. Jefferson attended academies in Kentucky and Mississippi, and in 1821 he entered Transylvania University in Kentucky. Three years later he was appointed to West Point and was graduated in 1828.

He served in frontier posts in Illinois and Wisconsin and in the Black Hawk War in 1832. Next year he fell in love with Sarah Taylor, the daughter of his commandant, Col. Zachary Taylor. The colonel did not approve of the match; so Davis resigned his commission in June 1835. Sarah went to an aunt in Kentucky, and there the two were married. Joseph helped him establish a plantation (Brierfield) on land in Mississippi. Within three months, tragedy struck. The young couple fell ill with malaria and Sarah died.

Davis spent the next ten years building up his plantation. He often worked in the fields with his slaves and was unfailingly kind to them. He even allowed them to have their own juries for settling their quarrels.

In 1845 he married Varina Howell (*see* Davis, Varina). By this time he was a successful planter. He developed a deep devotion to Southern plantation life and his own attitude toward his slaves led him to deny fiercely all Northern claims that slavery was cruel.

He was elected a representative to Congress in 1845, but he resigned the next year when the Mexican War broke out. He became a colonel of Mississippi volunteers and served under his former father-in-law, now General Taylor. At the battle of Buena Vista, Davis and his regiment probably saved the American army from defeat. Davis was severely wounded. This action made him widely known as "the hero of Buena Vista." It also convinced him that he was a military genius. This belief later handicapped him in his relations with Confederate commanders.

Jefferson Davis and his second wife, Varina Howell Davis, were a devoted pair. Despite the 18 years' difference in their ages, Mrs. Davis was her husband's valued adviser in political affairs.

In 1847 Mississippi sent him to the United States Senate. His ability as a speaker soon made him a Democratic leader, championing the South and slavery. In 1851 he resigned to run for governor of Mississippi. He was defeated; but he re-entered public life when Franklin Pierce became president in 1853. Davis became secretary of war, serving until the end of Pierce's term in 1857.

Mississippi again sent him to the Senate. By this time the tension between the North and the South over slavery was at fever heat. Davis took an unyielding attitude in favor of slavery. In 1860 he helped nominate a proslavery Democrat, John C. Breckenridge, to run against both Abraham Lincoln, the Republican nominee, and Stephen A. Douglas, the northern Democratic nominee. This party split caused Lincoln to be elected.

Southern bitterness made secession inevitable. On Jan. 21, 1861, Davis made an impassioned speech to the Senate and resigned. When the Southern states

formed the Confederacy he hoped to be named commander of the Confederate forces Instead he was named president He was inaugurated Feb 18, 1861 (*See also* Confederate States of America)

In spite of poor health he plunged into his task The Southern people were united in thought and feeling and at first Davis administration was highly popular Time brought military reverses and criticism began Davis took more and more power into his own hands until even his own officials at Richmond complained

Davis was not indifferent to the personal liberty of his people but he was dictatorial in manner His experience both as an army officer and as a slaveholder had developed in him self-confidence and habits of command On the whole he made few blunders and in the midst of hostile criticism he continued to work hard for the Southern cause

Finally as the blockade of the Southern coasts threw the people more and more on their own diminishing resources the struggle became hopeless Still Davis was unwilling to give up In his last message dated March 13 1865 he declared that in spite of reverses, success might yet be secured Less than 30 days after this Lee surrendered and shortly after, Davis was captured by United States troops near Irwinsville Ga (*See also* Civil War American)

Davis was confined at Fortress Monroe His sufferings there aroused the sympathy of the Southern people Even those who had found fault with his policies now regarded him as a martyr to their cause After two years he was released on bail Horace Greeley and other prominent Northern men becoming his bondsmen

As soon as he was free he journeyed to Canada and Europe in an attempt to regain his health Upon his return to the United States he tried to retrieve his broken fortunes His business ventures proved failures, and in 1878 he retired The rest of his life was spent writing his book *The Rise and Fall of the Confederate Government* He died in New Orleans on Dec 6 1889 His body was later removed to the old Confederate capital Richmond, Va A monument now stands in Richmond to the memory of "Jefferson Davis the first and only President of the Confederate States of America', and another was erected to his daughter Winnie Davis the Daughter of the Confederacy '

DAVIS, VARINA HOWELL (1826–1906) The first lady of the Confederacy was Varina Howell Davis As the wife of Jefferson Davis she shared the rise and fall of his political fortunes She was a bride of 19 when Davis entered Congress In Washington she was a popular and witty hostess When Davis left for service in the Mexican War she proved herself a capable manager of their Mississippi plantation Brierfield As the Confederate first lady, she was her husband s steadfast companion ignoring the criticism and abuse leveled against both of them For a time after the Civil War she shared his imprisonment at Fortress Monroe

Varina Howell was born May 7, 1826, near Natchez Miss She was tutored at home and later attended a girls' school in Philadelphia She married Davis in 1845 She followed her husband s career closely, advised him on appointments and often served as his personal secretary After his death she wrote a two-volume biography of him She died Oct 16, 1906, surviving all but one of her six children

DAVY, SIR HUMPHRY (1778–1829) One of England s leading men of science Sir Humphry Davy is best known for his invention of the miner s safety lamp His pioneer researches in electrochemistry led him to isolate sodium and potassium proving that these substances were elements not compounds as was previously thought

Davy made many contributions to modern science

Davy was born Dec 17, 1778 in Penzance Cornwall in England He was the eldest of five children At school he was a bright popular boy who liked reading but who paid little attention to his other studies His father died when the boy was 16 years old and Humphry was apprenticed to a surgeon-apothecary In his master s laboratory the boy soon developed a keen interest in chemistry Before he was 20 he was appointed laboratory head of the new Pneumatic Institution at Bristol

Here his work was to superintend experiments on the effect of breathing certain gases He used himself as a human guinea pig and once nearly killed himself by inhaling a mixture of carbon monoxide and hydrogen gas He discovered the properties of laughing gas (nitrous oxide) His published articles on oxygen and nitrous oxide brought him fame In 1801 he was appointed assistant lecturer in chemistry and director of the laboratory at the new Royal Institution and ten weeks later he became professor there Using a powerful galvanic battery he isolated sodium and potassium, and proved them elements He made special stud es of tanning and agricultural chemistry In 1808 though England and France were at war Napoleon gave him the medal for the year s best experiment in galvanism In 1812 he was knighted, the same year he married Mrs Jane Apreece, a wealthy widow They had no children In 1820 he was made president of the Royal Society of England For several years Michael Faraday was his laboratory assistant (*see* Faraday)

Davy s name will always be associated with his safety lamp for miners In this device the flame was screened by wire gauze so that not enough heat could pass through to set the surrounding gases afire Coal mines had always been extremely dangerous because the miners lamps frequently caused firedamp (methane gas) in the air to explode Davy's safety lamp did much to prevent such explosions For this invention he was made a baronet Davy died May 29, 1829

What Causes DAY *and* NIGHT?

DAY AND NIGHT. In early times men wondered what caused day and night. Many ancient people thought the sun was a god. They believed that he rose from sleep in the morning and drove his flaming chariot across the sky during the day. At night, they thought, he stabled his horses and went to bed, and the earth was in darkness until he woke again.

Primitive people used such stories to explain what they saw and could not understand. Later, men stopped believing the story about the sun-god, but they still did not know what made day and night. They thought the sun moved around the earth in a great circle. When the sun was overhead, it was day. When the sun was under the earth, it was night.

What We See and What Actually Happens

Every morning we see the sun rise in the east. It continues rising, and for those of us who live in the Northern Hemisphere, moves southward. By noon we see it high in the southern sky. Throughout the afternoon it gradually descends toward the west. Finally we see it set below the western horizon.

This is what we see, but what really happens is quite different. The sun is actually standing still. The earth rotates on its axis, making one complete turn every 24 hours. The place where you live begins to turn into the sunlight at dawn. At noon it is in full sunlight, and then it starts to turn away. By evening, your place is moving toward the dark side, away from the sun. As night passes, it continues to turn. At dawn again, it comes into the light. The diagrams at the bottom of the page show what happens as the earth turns.

Names of the Days of the Week

People have always had some word for "day" and for "night." However, they did not always have names for the days of the week. The early Romans did not have a week at all. They reckoned days from certain times of the month they called *ides* and *calends* (*see* Calendar). The later Romans adopted the seven-day week that other nations had been using for centuries. Then they named the seven days after the sun, moon, and those five planets they knew about

In northern Europe during pagan times, Germanic nations took these Latin names for the days, but translated them into their own languages. Our English names come from Anglo-Saxon, the old language of England. The Romans had called the first two days of the week after the sun and moon, and so we call them Sunday (sun's day) and Monday(moon's day). The other five days of the week had been named for Mars, Mercury, Jupiter, Venus, and Saturn. For these, the Anglo-Saxon people used names of their own gods that corresponded to the Roman gods. Tuesday was the day of Tiw, the war god; Wednesday the day of Woden, chief of the gods, Thursday the day of Thunor, the thunder god; Friday the day of Frig, goddess of marriage and wife of Woden. The Roman "Saturn's day" became Saturday, perhaps because no Anglo-Saxon god corresponded closely to the Roman deity.

What Is a Day?

Primitive people usually thought of a day as simply the daylight hours. (We still use the word day to mean this, as in "day and night.") Later, men began to call the whole 24-hour period of light and darkness a day. This is the time taken by the earth to complete one rotation. Some people made the 24-hour day begin at sunset. Even today the Jews and a few Christian sects observe their Sabbath and other holidays from one sundown to the next. The Roman civil day, however, changed at midnight, and most modern nations follow this practice.

At the equator daytime (from sunrise to sunset) and nighttime are each always 12 hours long. North and south of the equator, days are longer than nights in summer and shorter in winter. At the North Pole and South Pole, the sun never sets during the spring

HOW DAY FOLLOWS NIGHT AS THE EARTH TURNS

Imagine standing off in space and seeing the earth rotate, making one complete turn in 24 hours. Half the earth is always in darkness (night) and half in sunlight (day). This experiment duplicates the imaginary experience. The three positions shown are sunrise, noon, and sunset. The figure on the globe moves from light to darkness, just as people on earth actually do.

and summer months and never rises during most of the autumn and winter This is what people mean when they say that day and night are each six months long at the poles (For detailed explanations of the measurements of day and night *see* Time)

DAYLIGHT SAVING TIME In 1784 Benjamin Franklin wrote an amusing article on the advantages of setting clocks ahead to provide more waking hours of daylight Few people gave any serious consideration to the idea until 1907 That year William Willett in England started a movement to save daylight in just this way Setting clocks ahead in summer he pointed out would get people up earlier and give more time for daylight activities in the evening

During the first and second World Wars the United States officially adopted year round daylight-saving time In peacetime communities use standard time or daylight-saving time according to local preference Those that adopt daylight-saving time usually keep clocks one hour ahead of standard time during the spring and summer months starting the last Sunday in April and ending the last Sunday in September Except for suburban lines that serve only these communities railroads observe standard time the whole year Some airlines are adopting daylight-saving time schedules

DAYTON, OHIO When a group of Revolutionary War veterans founded Dayton in 1796 they endowed it with the energetic pioneer spirit which has marked its history It has been a city of bold attempts and successful experiments

Dayton straddles the Miami River in southwestern Ohio at the point where it is joined by the Mad and the Stillwater rivers In 1913 the three rivers swollen by heavy rains swept down on the city with a great loss of life and property The citizens had hardly dug out of the mud before plans were under way to prevent another such disaster Within a few years the Miami Valley Conservancy District at a cost of more than 30 million dollars had built five dams and retarding basins—a model flood prevention program

Aviation history was made in Dayton Here the Wright brothers built the planes they used for their first flights (*see* Wright Brothers) Their experimental field is now part of Wright-Patterson Air Force Base headquarters of the Air Force s Air Matériel Command Orville Wright s home has been preserved by the city Other points of interest include the public library (founded 1847) the Art Institute the University of Dayton (Catholic) and the home of the Negro poet Paul L Dunbar now a museum

Dayton is one of the world s foremost manufacturers of precision products Most famous are its cash registers Other important manufactures include automobile and airplane parts machine tools gauges air-conditioning equipment electric refrigerators business office machines plastics and rubber products

The city was named for Jonathan Dayton one of its early promoters It became the Montgomery County seat in 1803 and was chartered as a city in 1841 In 1913 it became the first large city to adopt the city manager form of government Population (1950 census) 243 872

DEAF, EDUCATION OF Until recent times the so-called deaf and dumb were considered burdens to society They were thought to be hopelessly dull because they could not communicate with others Even as late as the 18th century the common law of England presumed them to be little more than idiots

Today we know that most deaf children have normal intelligence and can be trained by special methods to take useful places in society The development of these special methods is one of the most interesting chapters in the history of education

The first to establish a school for the deaf was the Abbé Charles Michel de l Épée (1712–1789) who devised the first finger alphabet He opened his school about 1760 at Paris The next step was the development of methods to train deaf children to *speak* Nearly all so-called deaf mutes have voices However they need special training to develop the power of speech because they cannot learn to speak by the normal method of imitating others Thomas Braidwood a Scottish teacher who opened a school for the deaf at London in 1783 is said to have taught speech but little is known about his methods

The 19th century brought notable advances The deaf were trained both to speak and to understand others by watching the motions of their lips This is called the *oral method* of training A great aid was *visible speech* invented by A Melville Bell of Edinburgh Visible speech consists of alphabetical characters showing the position of the vocal organs for each speech sound

Education of the Deaf in the United States

The earliest schools for the deaf in the United States used the sign method rather than the oral or speech method America s first permanent school for the deaf was founded in 1817 at Hartford Conn by Thomas H Gallaudet the father of deaf mute education in America Gallaudet College (founded 1864) at Washington D C the world s only institution for higher education of the deaf is named in his honor

Pioneers of the Oral Method

America s first school to use the oral method was the Clarke School for the Deaf established at Northampton Mass in 1867 In 1871 Alexander Graham Bell brought to the United States his father s system of visible speech (*see* Bell Alexander Graham) In 1887 he endowed at Washington D C the Volta Bureau for the Increase and Diffusion of Knowledge Relating to the Deaf This bureau supplies information on all matters relating to the deaf

Most of the deaf in the United States are now taught by the oral method Children who have learned to speak before they lose their hearing are relatively easy to teach Children who are not totally deaf can be taught to recognize various sounds and to correct and develop their speech with the use of specially constructed auditory training units

People who are hard of hearing but not deaf can be helped by wearing a hearing aid. Two types of aids are in use, the air-conduction receiver and the bone-conduction receiver. The first outwardly looks like a button, but the inner side is shaped to fit into the outer ear. This type is used unless the ear drum or mechanism of the middle ear has been badly damaged. In that case the bone-conduction hearing aid must be used. This is worn on a metal band across the head to contact the mastoid bone. Both types have microphones to pick up sound and amplifiers to increase volume and tone range. These, with a tiny electric battery, are contained in a pocket-size box.

DEARBORN, MICH. The city of Dearborn was formed after Henry Ford moved his automobile plant to the little town of Springwells in 1923. Close to the west of Springwells lay the town of Dearborn. The town flourished as the growing Ford plant and other new industries drew workers and their families, many of them foreign born. In 1925 Springwells changed its name to Fordson, and in 1928 Fordson and Dearborn united under the latter name. The city's rapid growth carried it to Detroit's western boundary.

Dearborn occupies a flat expanse that rises into low rolling hills to the west. Threading the city are the River Rouge and its tributary, the Branch River. The Rouge has been dredged to admit large lake boats to the Ford plant.

In the city are Henry Ford's birthplace, the large Ford estate, and the Edison Institute of Technology. The institute contains Thomas Edison's Menlo Park laboratory, a large industrial museum, and Greenfield Village (*see* Ford).

A few farms occupied the River Rouge site until after the War of 1812, when the Dearborn settlement was established. In 1837 a rail line connected Dearborn to Detroit and led to the settlement of the village of Springwells. Dearborn's government is the mayor-council form. Population (1950 census), 94,994.

DEATH VALLEY, CALIF. Long known to scientists and the public as a region rich in scientific and human interest, Death Valley is also famous as a scene of suffering in the gold rush of 1849. Here many gold seekers nearly lost their lives. They gave the valley its grim name.

The valley is a deep trough between the Panamint Range on the west and the steep slopes of the Amargosa Range on the east. It is about 140 miles long and 4 to 16 miles wide. Nearly 550 square miles of its area lie below sea level, and it contains the lowest dry land in the country, 282 feet below sea level. Less than 100 miles away towers Mount Whitney, 14,495 feet above sea level.

The scorching heat has reached a record of 134°F. in the shade. Despite this heat, more than 600 kinds of plants grow there, as well as rattlesnakes, lizards, and other animals. The average annual rainfall is a little over two inches. Water, piped from the warm mountain springs, irrigates the only ranch, which grows dates and alfalfa. Most of the year the bed of the Amargosa River is only a series of dry channels. White salts, mostly borax, crust great areas of the soil. These once provided nearly all the country's domestic borax. Death Valley National Monument was created in 1933. It consists of about two thirds of the valley and a small area in Nevada.

DEBATING. The word *debate* comes from Old French, meaning to "strike down." The formal debate follows a definite procedure. The subject to be argued is stated as a positive resolution. For example, "Resolved: That Women Should Receive the Same Pay as Men for Equal Work." The speakers are divided into two teams of two or three members each. The affirmative side upholds the resolution; the negative opposes it. Each has equal time to present its views.

The presentation of a debate falls into two parts: the constructive speeches and the rebuttals. In a typical debate, with two speakers on each side, the following order is generally observed: constructive speeches—affirmative, negative, affirmative, negative; and rebuttal speeches—negative, affirmative, negative, affirmative. The length of the speeches varies. Ten minutes is an average time for each constructive speech and five minutes for each rebuttal. A

DEATH VALLEY AND ITS SURROUNDING MOUNTAINS

The forbidding Panamint Range towers steeply above the valley floor of Death Valley. All the great eras of geological time are represented in the exposed mountain rocks. Wind, water, and molten lava helped shape Death Valley's distinctive features.

chairman who is neutral reads the resolution and introduces the speakers in turn

The most important element of good debating is sound preparation A debater should know not only the arguments for his own side, but also the probable arguments of his opponents He must read thoroughly to gain the background of the issue Members of a debating team usually divide the work of gathering source material All information is recorded on small "evidence' cards Each piece of evidence is placed on a separate card

Planning the Case

When the material has been gathered, the team plans the case Each side should analyze the resolution carefully Often more than one interpretation can be given a resolution The affirmative decides which interpretation to use The negative must prepare its side of the case to argue any interpretation the affirmative presents

From the evidence each side chooses three or four major contentions to support its case A *contention* is a statement of belief which can be proved with evidence and sound reasoning Minor contentions support major contentions The choice of evidence and the way of presenting it depend upon the audience before which the debaters will speak The debater must never forget that the main purpose of a debate is to win the audience to a desired point of view A debate *brief*, setting forth all probable contentions for both affirmative and negative, is an invaluable aid in planning a case

Before writing the individual speeches, each team should draw up a working outline The following model is based upon a question of wide interest

RESOLVED THAT WOMEN SHOULD RECEIVE THE SAME PAY AS MEN FOR EQUAL WORK

Introduction of Subject

I We use the term *pay* to include *wages* and *salary*
II By *work* we mean both manual and mental labor
III It is not to our purpose to trace the history of woman s activity in the economic order of the world
—For this has no direct bearing upon the subject
IV The subject to be discussed is of interest because—
A The number of women who are devoting themselves to business industrial and professional life is steadily increasing
B There is a growing movement in these fields to employ women in the same work that is done by men
C The modern economic order necessitates that every woman be fit and able to support those dependent upon her should the occasion arise
V If we can prove that women are entitled to equal wages with men because (a) they similarly contribute to the support of dependents (b) are as efficient as men in the same tasks performed and (c) are unjustly hindered by the law of supply and demand to the detriment of society we shall prove our proposition

Proof of the Argument

Women should receive the same pay as men for equal work because—
VI They contribute to the support of dependents since
A Three surveys made by the Woman s Bureau of the United States *Department of Labor reveal*
a In a study made of 843 mothers in Chicago Ill 68 per cent of the families had no support from the father in less than 20 per cent of the cases was the father a regular contributor
b More than half of 60 000 women investigated gave all their earnings to the family
c Among 17 000 unmarried women workers it was *found that 1 in 5 cared for a family which* was getting no help from male relatives and 1 in 11 was the sole earner in the family
B Women are as efficient in the same tasks performed
a Intellectually
1 Although there may be mental differences as yet unproved between men and women when measurement tests of efficiency are applied to men and women equal results are obtained
2 The very volume of women in the occupational fields testifies to their capability as
(a) There are more than 4 500 women lawyers 7 700 physicians 20 500 writers and editors 34 500 librarians 66 300 musicians and teachers of music 48 400 social workers 827 000 teachers
(b) In addition to those in the professions there are other thousands in business trade and industry
b Manually
1 In a New York factory women displaced men on machines that produced steel piece work and their daily piece total was higher than that which the men had attained
C Society suffers from the bonds placed upon women by the so called law of supply and demand for
— Business scientists point out that by underpaying women executives are hampering the very cause for which they are theoretically working—the cause of promoting the welfare of the individual and the community the cause of perfecting civilization for the benefit of all since
— to lower buying power is to lower the standard of living

Conclusion of the Argument

If then as we have tried to prove our statements in A B and C are correct women should receive the same pay as men for equal work

No set rule governs how many contentions each debater shall present But the first speaker should try to cover as many points as possible This gives the second speaker a chance to refute the opening arguments of the opposition Beginners should avoid memorizing their speeches Speaking extemporaneously permits greater flexibility, especially in rebuttal

The importance of the rebuttal in a debate cannot be overemphasized A debate is often won by an effective rebuttal In the rebuttal speeches the debaters must limit themselves to answering the attacks of their opponents No new contentions may be introduced But a speaker may introduce new evidence to refute or support an argument

DEBUSSY (*de-bü-se'*), **ACHILLE CLAUDE** (1862-1918) Even as a child the noted composer Achille-Claude Debussy was a rebel Instead of practising his scales and technical exercises he would sit at the piano

and experiment with different chord combinations. In later years his unusual chords, based on the whole tone scale, laid the groundwork for a new and unconventional style of music, called "impressionism."

Debussy did not come from a musical family. His father was a shopkeeper in Saint-Germain-en-Laye, a few miles from Paris. There Achille-Claude was born on Aug. 22, 1862. The family soon moved to Paris. At seven, Achille began taking piano lessons. His mother taught him to read and write at home. When he was nine his playing attracted Mme. Mauté de Fleurville, a former pupil of Chopin. Under her tutoring he was able to enter the Paris Conservatory two years later.

CLAUDE DEBUSSY

Modern music reflects the influence of this French composer.

At the conservatory the boy was hard working but stubborn. He studied intensely the subjects he liked, but refused to follow the traditional rules of music. He had his own ideas about harmony and theory and he fought for them stubbornly. Despite his rebellious ways, he won many awards.

Debussy was 22 when he was awarded the famous Prix de Rome. This prize was given annually to a member of the conservatory composition class for the best original work. Debussy's entry was a cantata, 'L'Enfant prodigue'. Part of the award was three years of study at the French Academy in Rome. Debussy found he could not compose in Rome, and so after two years he returned to Paris. About this time he began signing his name Claude instead of Achille. Among Debussy's Parisian friends were many artists and writers. Like himself, they had broken with tradition. They were known as "impressionists" and "symbolists" (*see* Painting). Debussy was particularly friendly with the poet Stéphane Mallarmé. It was Mallarmé's poem that inspired Debussy's famous composition 'L'Après-midi d'un faune' (The Afternoon of a Faun).

In 1892 Debussy began his most notable work, the opera 'Pelléas et Mélisande'. It was based on a play by Maurice Maeterlinck. When the opera was performed ten years later, the critics were skeptical. Meanwhile, Debussy had composed a number of other works. Best known of these was his cycle of 'Nocturnes' for orchestra. They are 'Nuages', 'Fêtes', and 'Sirènes'. His famous 'La Mer' (The Sea) was first heard in 1905.

Debussy was married twice. For his little daughter Chou-Chou he wrote the piano work 'The Children's Corner'. In it is the amusing 'Golliwog's Cakewalk'. In his last years Debussy suffered from cancer and was a semi-invalid. Many of his best piano pieces were composed during this period, however. He died March 25, 1918, as the Germans began the bombardment of Paris in the first World War.

DECA'TUR, STEPHEN (1779–1820). "The most daring act of the age," said Lord Nelson, the famous British admiral, of Lieutenant Decatur's exploit in Tripoli harbor, on the night of Feb. 16, 1804. Pirates from the Barbary States had captured the United States frigate *Philadelphia* and taken it into Tripoli harbor, Stephen Decatur, with a small ship and a small crew, slipped into the harbor, fired the *Philadelphia*, and escaped under the fire of 114 guns without the loss of a man. This deed made Decatur a captain in the United States Navy.

These pirates from the shores of Morocco, Algeria, Tunis, and Tripoli had for centuries been the terror of the Mediterranean, preying on the commerce of Christian nations and capturing Christians as slaves. It was Decatur who gave them their first lesson in law, one which was completed in 1815, when he returned with an American fleet and forced them to respect the American flag.

Almost from the day he was born, at Sinepuxent, Md., Decatur was close to the sea, for his father was a sailor. He became a midshipman at 19, a lieutenant at 20, and his men proudly called him captain at 25. In the War of 1812 his frigate, the *United States*, captured the British *Macedonian* on Oct. 25, 1812, after a desperate fight near Madeira Island. On Jan. 14, 1815, before news of the war's end reached America, four British frigates surrounded his ship, the *President*, off Long Island. After being wounded twice and losing one-fifth of his men he was forced to surrender.

STEPHEN DECATUR

A duel ended the brilliant naval career of Stephen Decatur.

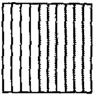
Decatur had become a commodore in 1813 and in 1815 was made a navy commissioner. At the peak of his fame he was killed by Commodore James Barron in a duel. Barron had been court-martialed in 1808 and the quarrel grew out of Decatur's refusal to reinstate him. Decatur has been called "the most conspicuous figure in the naval history of the United States, for the hundred years between Paul Jones and Farragut." His most quoted saying is the toast: "My country—may she ever be right, but right or wrong, my country!"

DECEMBER. When the old Roman calendar began with March, December was the *tenth* month, as its name indicates (from Latin *decem*, "ten"), but Julius Caesar made it the twelfth when he changed the time for the beginning of the year. It is pre-eminently the winter month, for in it comes the winter solstice, December 21 or 22 (*see* Equinox and Solstice).

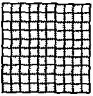
How to Use
DECIMAL FRACTIONS

DECIMALS Numbers such as 4 and 07 are called *decimal fractions* or simply *decimals* The same numbers may be written as $\frac{4}{10}$ and $\frac{7}{100}$ They are then called *common fractions* or simply *fractions* (*see* Fractions) Both are read in the same way 'four tenths" and 'seven hundredths As may be seen from the diagrams below either type of fraction may be used to express the same fractional part of one whole

4 or $\frac{4}{10}$



07 or $\frac{7}{100}$



In a common fraction the number below the line is the *denominator*, and the number above the line is the *numerator* In a decimal fraction we omit the denominator and place a dot called a *decimal point* in front of the numerator The denominator of a common fraction may be any number The unwritten denominator of a decimal fraction is always 10, 100, 1000 or some other power of 10 (*see* Powers and Roots)

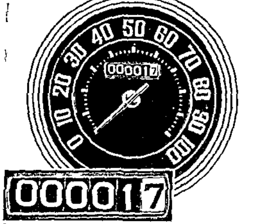
Common fractions have been used for a longer time than have decimal fractions In fact decimal fractions did not appear until the latter part of the 16th century Decimals are easier to write and to print than are common fractions It is also easier to compute with them For these reasons decimals have come to be widely used in business science, and statistics Their most common use is in measurements They appear on surveyors tapes and micrometers and are used in the financial and sports pages of newspapers Automobiles register distance traveled in decimal fractions and gasoline pumps measure gas in tenths of a gallon (*See* Measurements, Micrometer)

How to Read Decimals

If there is only one figure to the right of the decimal point, we say 'tenths' when we read the decimal For example we read 1 as '*one tenth*"

If there are two figures to the right of the decimal point, we say "hundredths" For example we read 24 as "*twenty four hundredths*" and 06 as "six hundredths"

If there are three figures to the right of the decimal point, we say "thousandths" We read 256 as "two hundred fifty-six thousandths" 075 as 'seventy-five thousandths," and 008 as "eight thousandths"



The speedometer in an automobile tells how fast the car is going The odometer on the same dial registers the total distance traveled in miles and tenths of a mile The tenths are decimal fractions This odometer registers 1 7 miles

Four figures to the right of the decimal point are read as "ten thousandths' We read 3852 as "three thousand eight hundred fifty two ten thousandths"

After ten thousandths there are hundred thousandths millionths ten millionths and so on but numbers with so many decimal places are not often seen

If a number has figures both to the left and to the right of the decimal point, the number is a *decimal mixed number* The number 2 38 is read "two and thirty-eight hundredths" The word *and* is used only where the decimal point appears in order to separate the whole number from the decimal fraction 'Three hundred seventy five thousandths' would be written 375 Three hundred *and* seventy five thousandths' would be written 300 075 To avoid confusion the business practice for reading decimals is to say "point" instead of "and" For example, the number 2 38 would be read 'two point three eight"

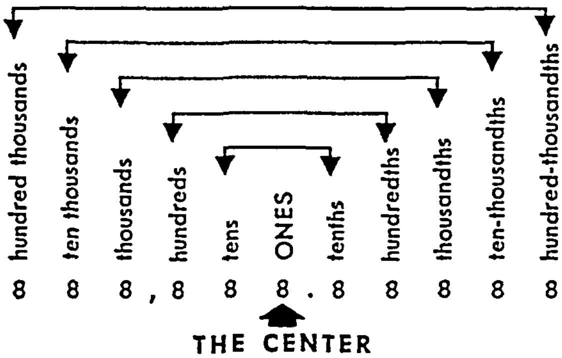
Decimals Are an Extension of Place Value

The odometer in an automobile (pictured above) shows clearly the use of place value in our number system The tenths' counting wheel turns continuously when the car is moving Each time it reaches 0, the figure on the ones wheel increases by one When the ones' wheel reaches 0 the next figure to the left, in tens' place, increases by one

As explained in the article Number System, the value of each figure in a number depends not only upon the absolute value of the figure itself (such as 8) but on the place where the figure is written From right to left, *place value* increases tenfold—from ones to tens to hundreds, and so on Zero is a place holder, used to fill an empty space The complete development of place value came about when it was discovered that by using a dot—the decimal point—after the whole number, place value could be ex-

tended to the right of one's place to show values of less than 1. As shown in the chart, the *ones* then became the center of the number system.

ORDERLY PATTERN OF OUR NUMBER SYSTEM



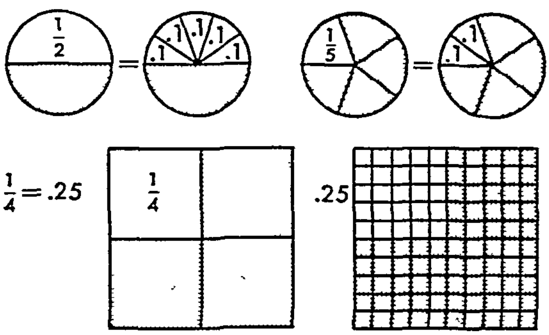
The chart shows the values of the various places for the number 888,888.88888. Arrows connect tens and tenths, hundreds and hundredths, and so on. Note that the number system is centered about the ones' place rather than about the decimal point.

In the number 888,888.88888, each 8 has ten times the value of the 8 on its right and one tenth the value of the 8 on its left. This is true for the 8's on both sides of the decimal point. The 8 at the extreme left represents the number 800,000, which is ten times 80,000, the number represented by the second 8. Also it will be seen that the first 8 represents a number one hundred times as large as that represented by the third 8, one thousand times as large as that represented by the fourth 8, and so on. The complete number is read: "888 thousand, 888 *and* 88 thousand, 888 hundred-thousandths."

800,000.00000
80,000.00000
8,000.00000
800.00000
80.00000
8.00000
.80000
.08000
.00800
.00080
.00008

How to Change Common Fractions to Decimals

It is easy to change some common fractions to decimals even though the denominators are not 10, 100, or some other power of ten. We do this by applying one of the "golden rules" of fractions: *Multiplying both terms of a fraction by the same number does not change the value of a fraction.* (*See* Fractions.)



For example, we can change $\frac{1}{2}$ to tenths by multiplying both the numerator and the denominator by 5. Then: $\frac{1}{2}=\frac{5}{10}=.5$. Also: $\frac{1}{5}=\frac{2}{10}=.2$. In the same way, we can easily change $\frac{2}{5}$, $\frac{3}{5}$, and $\frac{4}{5}$ to tenths.

We cannot change $\frac{1}{4}$ to tenths, but, using the same rule, we can change it to hundredths. To do this, we must multiply both the numerator and the denominator by some number that will change the denominator to 100. We find this number, 25, by dividing 100 by 4. Then: $\frac{1}{4}=\frac{25}{100}=.25$. In the same way we can change $\frac{3}{4}$ to hundredths: $\frac{3}{4}=\frac{75}{100}=.75$.

Suppose we want to change $\frac{5}{6}$ to hundredths (Example A). We discover, when we divide 100 by 6, that there is no whole number we can use to multiply 6 and get 100. The quotient is 16 with a remainder of 4. In such cases, we use a different method (Example B). We know that the number 1 is equal to $\frac{100}{100}$. Then $\frac{5}{6}$ must be equal to $\frac{5}{6}$ of $\frac{100}{100}$, or $\frac{5}{6}\times\frac{100}{100}$, or $\frac{5\times100}{6}$ hundredths, or $\frac{500}{6}$ hundredths, or 83 hundredths, approximately. To change $\frac{5}{6}$ to hundredths, then, we annex two zeros to the numerator and divide by the denominator. To change $\frac{5}{6}$ to thousandths, we annex three zeros to the numerator (because there are three zeros in 1000) and then divide by the denominator. The fraction $\frac{5}{6}$ is equal approximately to 833 thousandths, or .833. We say "approximately" because there is a remainder.

A

```
   16
6)100
  6
  40
  36
   4
```

B

```
         .833
5/6 = 6)5.000
        4 8
          20
          18
           20
           18
            2
```

RULE: *To change any common fraction to a decimal, annex one or more zeros to the numerator and then divide by the denominator.*

If the division does not come out even, we carry it far enough to get as many decimal places in the answer as we desire. In Example C, the answer is carried to five decimal places. If we had carried the answer to four decimal places we should say .4286 instead of .4285 because .4286 is nearer .42857 than is .4285; to three decimal places, $\frac{3}{7}=.429$; to two decimal places, $\frac{3}{7}=.43$; to one decimal place, $\frac{3}{7}=.4$. Each of these answers is only approximately correct because there is still a remainder.

C

```
          .42857
3/7 = 7)3.00000
        2 8
          20
          14
           60
           56
            40
            35
             50
             49
              1
```

Example D shows $\frac{1}{12}$ changed to a four-place decimal. In this example it was necessary to annex two zeros to the numerator, 1, before getting the first figure of the quotient, 8. Annexing

D

```
            .0833
1/12 = 12)1.0000
           96
            40
            36
             40
             36
              4
```

one zero gave us no tenths in the quotient because 10 is smaller than 12 We placed a zero in the quotient as a place holder to show that there are no tenths there and to make the 8 mean 8 hundredths

Rule When a fraction is changed to a decimal the number of decimal places in the quotient must always be the same as the number of zeros which are annexed to the dividend (numerator)

How to Change Decimals to Common Fractions

To change a decimal fraction to a common fraction we simply drop the decimal point write the denominator and reduce the fraction to lower terms if possible Thus

$$8=\frac{8}{10}=\frac{4}{5} \qquad 65=\frac{65}{100}=\frac{13}{20} \qquad 625=\frac{625}{1000}=\frac{5}{8}$$

$$23=\frac{23}{100} \qquad 017=\frac{17}{1000}$$

The last two fractions cannot be reduced

ADDITION

We add decimals in the same way that we add whole numbers (*see* Addition) The main point to watch is the placement of the decimal point We write the example so that the decimal points are in a straight column Then we add and carry just as we do when adding whole numbers and place a decimal point in the sum directly beneath the decimal points above

In Example A we know that the sum 9 is correct because $\frac{2}{10}+\frac{4}{10}+\frac{3}{10}=\frac{9}{10}$ or 2 tenths+4 tenths+3 tenths=9 tenths Changing Example B to common fraction form we have $\frac{6}{10}+\frac{1}{10}+\frac{8}{10}$ $\frac{15}{10}=1\,5$ or 6 tenths+1 tenth+8 tenths=15 tenths=1 and 5 tenths=1 5

A	B
2	6
4	1
3	8
9	1 5

C
6 18
3 77
39
10 34

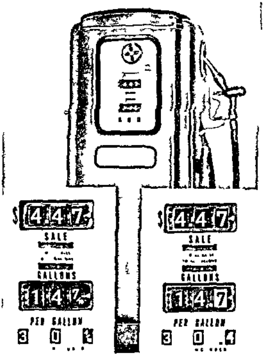
In Example C we add and carry just as we would do if there were no decimal points Adding the hundredths (8+7+9) we get 24 hundredths or 2 tenths and 4 hundredths We write the 4 in the hundredths place and carry the 2 tenths to the tenths column Adding the tenths (2 carried +1+7+3) we get 13 tenths or 1 and 3 tenths We write the 3 in the tenths place in the sum and carry the 1 to the ones column

We Do Not Add or Subtract "Ragged" Decimals

Each of the numbers in an addition or subtraction example must have the same number of decimal places Most decimals are derived from measurements and measurements with decimals are always expressed to the same decimal place If the thicknesses of two pieces of wood are given as 3 7 inches and 1 68 inches we might suppose that the first piece was measured to the nearest tenth of an inch and the second to the nearest hundredth of an inch The first piece therefore might be any thickness from 3 65 to 3 74 If it is 3 70 inches it should be so written

	Wrong		Right	
	3 7		3 70	3 7
	1 68		1 68	1 7
	?		5 38	5 4

IT MULTIPLIES DECIMAL FRACTIONS



Filling station pumps register automatically each tenth gallon of gasoline put into the tank of a car and compute the cost. To check the multiplication we could write 14 7/10 as 14 7

SUBTRACTION

We subtract decimals in the same way that we subtract whole numbers using the same method of regrouping or borrowing (*see* Subtraction) We write the example so that the decimal points are in a straight column subtract and place a decimal point in the answer directly beneath the decimal points above Each of the numbers in a subtraction example must have the same number of decimal places

DECIMAL EQUIVALENTS OF THE MOST COMMONLY USED FRACTIONS

$\frac{1}{2}=5$	$\frac{1}{5}=2$	$\frac{3}{8}=375$
$\frac{1}{4}=25$	$\frac{2}{5}=4$	$\frac{5}{8}=625$
$\frac{3}{4}=75$	$\frac{3}{5}=6$	$\frac{7}{8}=875$
$\frac{1}{3}=33\frac{1}{3}$	$\frac{4}{5}=8$	$\frac{1}{6}=16\frac{2}{3}$
$\frac{2}{3}=66\frac{2}{3}$	$\frac{1}{8}=125$	$\frac{5}{6}=83\frac{1}{3}$

In Example A, we see that we cannot subtract 7 hundredths from 2 hundredths. We "borrow" 1 of the 4 tenths, changing it to 10 hundredths. Combining this 10 hundredths with the 2 hundredths, we have 12 hundredths. Subtracting 7 hundredths from 12 hundredths, we have 5 hundredths. We remember that we used 1 of the 4 tenths *and that there are only 3 tenths left. Subtracting 1* tenth from 3 tenths, we have 2 tenths. The answer is 2 tenths and 5 hundredths, or 25 hundredths, or .25.

$$\text{A}\quad \begin{array}{r} .42 \\ \underline{.17} \\ .25 \end{array}$$

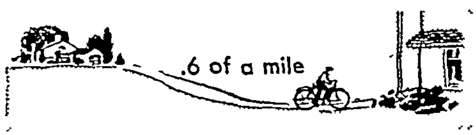
In Example B, we change 1 of the 2 hundredths to 10 thousandths, combine it with the 6, giving us 16 thousandths, and then subtract 7 thousandths, leaving *9 thousandths. We proceed as in Example* A, changing 1 of the 4 tenths to hundredths and subtracting the 5 hundredths from the 11 remaining hundredths. Before subtracting the 8 tenths we must change 1 of the 3 ones to tenths, making 13 tenths in tenths' place. The remainder of the example is similar to an example in the subtraction of whole numbers.

$$\text{B}\quad \begin{array}{r} 73.426 \\ \underline{49.857} \\ 23.569 \end{array}$$

MULTIPLICATION

There are three different kinds of examples in the multiplication of decimals. In all of them the process of multiplying is the same as for whole numbers (*see* Multiplication). The three types differ only in the rules for the placement of the decimal point in the answer. Absurd answers caused by the wrong placement of the decimal point can be avoided by estimating the answer in advance and applying the "check of common sense" to the solution.

1. Multiplying a Decimal by a Whole Number. The distance from Dick's house to his school is .6 of a



mile. If he rides this distance on his bicycle 4 times a day, how far does he ride? We can find the answer by addition or by multiplication. It is easy to see by adding that the distance is 2.4 miles. The multiplication example may seem easier at first if it is written in a different form. We multiply 6 tenths by 4, as shown. The product is 24 tenths, or 2 and 4 tenths, or 2.4.

$$\begin{array}{r} .6 \\ .6 \\ .6 \\ \underline{.6} \\ 2.4 \end{array} \qquad \begin{array}{l} 6 \text{ tenths} \\ \underline{\times 4} \\ 24 \text{ tenths} = 2.4 \end{array} \qquad \begin{array}{r} .6 \\ \underline{\times 4} \\ 2.4 \end{array}$$

RULE: If a decimal is multiplied by a whole number, the number of decimal places in the product is the same as the number of decimal places in the number multiplied.

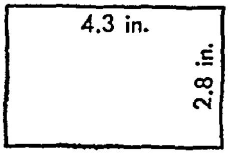
2. Multiplying a Whole Number by a Decimal. If a certain kind of cloth costs 32¢ a yard, then $2\frac{1}{2}$ yards, or 2.5 yards, would cost 2.5 times 32¢. It is easy to see that 2 yards would cost 64¢ and 3 yards would cost 96¢. The cost of 2.5 yards would therefore have to be between 64¢ and 96¢. The product of 2.5×32¢ is 800 without the decimal point. Common sense tells us that the cost could not be as much as $8.00 or as little as 8¢. The answer (80¢) can easily be verified by multiplying 32¢ by $2\frac{1}{2}$ in common fraction form:

$$\begin{array}{r} 32¢ \\ \underline{2.5} \\ 160 \\ \underline{64} \\ 80.0¢ \end{array}$$

$$2\frac{1}{2}\times 32¢=\frac{5}{\cancel{2}_{1}}\times \cancel{32¢}^{16}=80¢$$

RULE: If a whole number is multiplied by a decimal, *the number of decimal places in the product is the* same as the number of decimal places in the multiplier.

3. Multiplying a Decimal by a Decimal. A rectangle is 4.3 inches long and 2.8 inches wide. Since the area of a rectangle in square inches is the product of the length in inches and the width in inches, the area must be the product of 4.3×2.8 (*see* Measurement). Estimating the answer in advance, we see that since the length is about 4 inches and the width is about 3 inches, the area must be about 12 square inches. Multiplying as usual, we get the figures 1204 as the product. The answer must be 12.04. It could not be as much as 120.4 or as little as 1.204.



$$\begin{array}{r} 4.3 \\ \underline{2.8} \\ 344 \\ \underline{86} \\ 12.04 \end{array}$$

The gas pump pictured on the preceding page shows that the cost of 14.7 gallons at 30.4¢, or $.304, a gallon is $4.47. If we multiply in the usual way, the work appears as shown at the left. To the nearest cent, the product is $4.47.

$$\begin{array}{r} \$\quad .304 \\ \underline{14.7} \\ 2128 \\ 1216 \\ \underline{304} \\ \$4.4688 \end{array}$$

RULE: If a decimal is multiplied by a decimal, the number of decimal places in the product is equal to the number of decimal places in the number multiplied plus the number in the multiplier.

This rule is easily verified by working a few examples in common fraction form. As an illustration, find the product of 3.7×1.9. In common fraction form the work appears as follows:

$$3\frac{7}{10}\times 1\frac{9}{10}=\frac{37}{10}\times\frac{19}{10}=\frac{703}{100}=7\frac{3}{100}$$

In decimal form, the work appears as shown at the left. Since $7\frac{3}{100}=7.03$, it is clear that the rule given above for the placement of the decimal point in the product is correct.

$$\begin{array}{r} 1.9 \\ \underline{3.7} \\ 133 \\ \underline{57} \\ 7.03 \end{array}$$

DIVISION

The process of division with decimals is the same as the process with whole numbers (*see* Division). The decimal point, however, needs to be carefully watched.

1 Dividing a Decimal by a Whole Number Just as 6¢ divided by 2=3¢ 6 tenths divided by 2=3 tenths and 6 hundredths divided by 2=3 hundredths If

```
  3 tenths        3
2)6 tenths     2)6

  3 hundredths    03
2)6 hundredths 2)06
```

cents are divided the quotient is cents if tenths are divided the quotient is tenths if hundredths are divided the quotient is hundredths and so on

RULE If a decimal is divided by a whole number the number of decimal places in the quotient is the same as the number of decimal places in the dividend

```
A   04      B   0416
  6)25        6)2500
    24          24
     1           10
                  6
                 40
                 36
                  4
```

Sometimes when there is a remainder we annex zeros to the dividend and continue the division In Example A (25 divided by 6) the quotient is 04 and there is a remainder of 1 (really 01) In Example B we annex two zeros continue the division and obtain the quotient 0416 Since the remainder 4 is more than one half of the divisor 6 the quotient to the nearest ten thousandth is 0417

2 Dividing a Whole Number by a Decimal Example C asks us to find how many 2 s there are in 4 We may easily discover the answer by thinking of 2 as $\frac{1}{5}$ There are five $\frac{1}{5}$ s in 1 in 4 there are four times five $\frac{1}{5}$ s or twenty $\frac{1}{5}$ s

```
C 2)4
```

The answer is 20 that is

$$4 \div \tfrac{1}{5} = 4 \times \tfrac{5}{1} = 20$$

We get the same answer 20 if we annex a zero to the dividend and then divide as usual (*Example D*) Annexing a zero makes the dividend 4 appear as 4 0 or 40 tenths The number of 2 tenths in 40 tenths *obviously is 20*

```
D    2 0
   2)4 0

E     2 00
   02)4 00
```

In Example E the divisor is 02 *instead of* 2 We annex two zeros to the dividend and the quotient is *200 instead of 20*

RULE When we divide a whole number by a decimal fraction we always annex to the dividend as many zeros as there are decimal places in the divisor The quotient then is a whole number *If there is a remainder we may annex more zeros and continue the division* The quotient is then a decimal mixed number

```
F      62 5
  08)5 000
     4 8
      20
      16
       40
       40
```

In Example F we annex three zeros to the dividend

All the above examples may *be checked by multiplying the* quotient by the divisor and comparing the result with the dividend *In the last example we* multiply 62 5 by 08 and get 5 000 *which is the same as the dividend*

3 Dividing a Decimal by a Decimal Sometimes there are decimal places in both the *divisor* and the dividend If the number of decimal places in the divisor is greater than the number in the dividend we annex zeros to the dividend *to make up the difference In Example G* we must annex one zero to the dividend The example then becomes 02)40 The quotient is 20

```
G 02)4
```

Example F (5 000 divided by 08) suggests what we should do if the number of decimal places in the dividend is greater than the number in the divisor We saw there that the number of decimal places in the divisor (2) plus the number in the quotient (1) equals the number in the dividend (3) Or the number of *decimal places in the dividend (3) minus* the number in the divisor (2) equals the number in the quotient (1)

RULE The number of decimal places in the dividend minus the number of places in the divisor equals the number of places in the quotient

The same rule applies if the divisor and dividend are decimal mixed numbers Two illustrations follow

In Example H we divide 6 816 by 2 13 The quotient is a 3 and a 2 Subtracting the number of decimal places in the divisor (2) from the number in the dividend (3) we obtain the number of decimal places in the quotient (1) Applying the check of common sense we see that we are dividing 6 and a fraction by 2 and a fraction

```
H         3 2
   2 13)6 816
        6 39
          426
          426
```

Clearly the quotient must be about 3 If the figures of the quotient are 3 and 2 the quotient must be 3 2

In Example I we are to divide 2 65 by 1 304 Before we begin the division we see that the quotient must be about 2 We also see that we cannot very well subtract the number of decimal places in the divisor from the number of places in the dividend to determine the number of places in the quotient There are three decimal places in 1 304 but only two decimal places in 2 65 Before we begin to divide we annex a zero to the dividend

```
I 1 304)2 65

           2 03
  1 304)2 65000
        2 608
           4200
           3912
            288
```

making it appear as 2 650 The quotient is 2 and there is a remainder of 42 Annexing two more zeros to the dividend and continuing the division we obtain the quotient 2 03 correct to two decimal places

Decimals in the School Program

The tendency in the modern school program is to introduce addition and subtraction of decimal fractions late in Grade 5 limiting the work to tenths and hundredths In Grade 6 the subject is retaught thousandths and ten thousandths are introduced and experiences with multiplication and division are provided *In Grade 7 after further reteaching* the decimal system is extended to hundred thousandths and experience is provided with more elaborate examples in each of the four fundamental processes A review of the subject and some mention of six place decimals appear in Grade 8 In each of these grades the learning of decimals is motivated by deriving much of the problem material and many of the exercises from realistic and interesting social situations

ANNOUNCING *the* BIRTH *of a* NEW NATION

DECLARATION OF INDEPENDENCE. On July 4, 1776, the members of the Continental Congress assembled at the State House in Philadelphia to take up a matter of vital importance. Two days earlier the Congress had voted to declare the colonies to be "free and independent states." Now they were considering how to announce that fact to the world. By the end of the day, the final wording had been determined and the Congress voted unanimously to adopt one of history's greatest documents—the Declaration of Independence.

The stirring phrases of the Declaration inspired the patriots to defeat the British military forces and thus guarantee their independence (*see* Revolutionary War). Since that time the Declaration has been a source of pride and strength for every generation of Americans.

The Movement Toward Independence

When the Revolutionary War broke out at Lexington and Concord, April 19, 1775, few colonists desired independence. Most of them wanted only a larger measure of self-government within the British Empire. In June 1775 General Washington promised to work for "peace and harmony between the mother country and the colonies" As late as September, Thomas Jefferson "looked with fondness towards a reconciliation."

Although they wanted to remain in the British Empire, most of the colonies insisted that they have the right of self-government. As the year 1775 wore on, however, it became clear that both of these goals could not be achieved. Parliament would not repeal the "five intolerable acts" or admit that only the local assemblies could tax the colonists. In August the king called the patriots "rebels," and summoned all British subjects to aid in bringing them to terms. In December he removed the colonies from his protection and blockaded their ports. In effect, then, the king had begun war almost a year before the Declaration was adopted.

The ravages of war were making the people more and more bitter. In October 1775 the British burned the town of Portland, Me., destroying the homes of a thousand people just at the approach of winter. The siege of Boston inflicted severe hardships on its people. Then came the news that 20,000 Hessian troops had been hired to put down the revolt. "The king," wrote Jefferson, "has plundered our seas, ravaged our coasts, burnt our towns, and destroyed our people." The German mercenaries were intended "to complete his works of death, desolation, and tyranny." On the frontiers he had aroused "the merciless Indian savages, whose known rule of warfare" was the destruction of women and children. If the colonists had to preserve their rights by fighting, then they had to have the means of making war and trading with other nations. They could not, however, secure aid abroad so long as they were British subjects, nor could they make a treaty of commerce with a foreign state. First they must declare themselves independent.

The Declaration Is Framed

The time was ripe. In January 1776, Thomas Paine wrote a vigorous pamphlet 'Common Sense'. How, he asked, could the people at once fight against the king and profess their loyalty to him? The day of compromise had passed. "The blood of the slain, the weeping voice of Nature cries, 'Tis time to part'.

THE BIRTH OF A GREAT CHARTER OF FREEDOM

Thomas Jefferson is discussing his draft of the Declaration of Independence with Benjamin Franklin, who is reading the document, while John Adams listens. This picture, painted by J. L. G. Ferris, hangs in Independence Hall, Philadelphia.

Here is the vast continent of North America suited to become the home of a race of free men let it no longer lie at the feet of an unworthy king Thousands of men read this challenge and accepted the idea of *complete separation as inevitable*

In the spring of 1776 several states—North Carolina taking the lead—directed their delegates in Congress to declare for independence Virginia requested hers to make the necessary motion Accordingly one of her spokesmen Richard Henry Lee, introduced on June 7 1776, a resolution which declared that these United Colonies are and of right ought to be Free and Independent States, that they are absolved from all allegiance to the British Crown and that all political connection between them and Great Britain is and ought to be totally dissolved"

Since not all the states had yet told their delegates to vote for separation, this resolution was not immediately adopted But a committee of five—John Adams, Thomas Jefferson, Benjamin Franklin Roger Sherman, and Robert Livingston—was appointed to prepare a statement of the American case Jefferson was chosen to draw up this declaration, for he had already won renown as a skillful and persuasive writer He presented a rough draft to Adams and Franklin who suggested minor changes Then the corrected paper was brought into Congress *on June 28 On July 2 the* Lee resolution was adopted Jefferson s Declaration was debated until July 4 when it was adopted by Congress, with some modifications Contrary to early tradition the signing of the Declaration did not take place on that day On July 19 a copy was ordered engrossed on parchment This document was submitted to Congress on August 2 and signed on that date by the members present Members who were absent signed later at various times

BOSTON RECEIVES THE TIDINGS OF LIBERTY

The excited crowd is listening to the Declaration of Independence being read from the Old State House in Boston. Couriers carried copies of the document to all parts of the country and the news aroused great enthusiasm.

Origin of the Declaration

Jefferson put little that was new into this famous document—the birth certificate of the United States Its ideas were the meat and drink of America at the time They had previously been popular in England, John Locke had used them in his widely read book 'Of Civil Government' *in defense of the* English Revolution of 1689 Nor did the Declaration actually establish the independence of the United States it merely stated an intention and the cause for action It must be converted into fact by force But once adopted there was no turning back

The Declaration is a statement of the American theory of government and an explanation of the Revolution God had made all men equal and had given them the rights of life liberty and the pursuit of happiness The main business of government was to protect these rights If instead it tried to take them from the people, they were free to discard it and to set up a new one in its place These ideas formed the groundwork of the new state governments erected after the Declaration was adopted

Abuses Charged Against the King

Who had deprived the colonists of their natural rights? Not Parliament, but the king Every abuse complained of was laid at his door He had never given America its rights the people had always been free, accepting him only while he treated them fairly But now, by a long series of usurpations, he had tried to make them slaves He had put through unpopular acts of Parliament with that intent Twenty-seven specific wrongs had he committed and Jefferson recited them

The colonists took this stand of protest against the king because if they acknowledged the authority of Parliament they could not easily refuse to abide by its laws They could however recognize the king as a past symbol of their kinship with England without conceding that he had ever had any real power Moreover, if the Declaration had attacked Parliament, it would have attacked the representatives of the British people Thus it would have blunted sympathy among the English for the American cause The king had powerful enemies at home who would be inclined to help the colonists if it was felt that they were fighting solely against him To foreigners the Revolution would not seem to be a revolt against an unquestioned authority—only a defense of rights long enjoyed and impossible to relinquish

Though cracked and voiceless, the Liberty Bell remains a symbol of the American faith. The biblical quotation (Lev. xxv, 10) around its crown says: "Proclaim liberty throughout all the land unto all the inhabitants thereof." As the lower inscriptions show, Pass and Stow recast it in Philadelphia in 1753 (MDCCLIII). Made of bronze, it weighs 2,080 pounds. It is three feet high and fully twelve feet around at the lip.

According to report, when the Declaration was accepted on July 4 the Liberty Bell hanging in the belfry of the old Pennsylvania State House, now known as Independence Hall first proclaimed the news to the people of Philadelphia The firing of cannon and racing horsemen carried the tidings far and wide Washington had the Declaration read to his army, and its ringing sentences strengthened the morale of the troops The patriots everywhere now had a close-up picture of a single foe America's grievances were no longer intangible laws, but the *misdeeds of a man of flesh and blood*

The Liberty Bell, brought from London in 1752, had cracked open later that year when first used in Philadelphia It was twice recast by Charles Stow and John Pass in 1753 before it proved satisfactory On July 8, 1776, it again fulfilled its purpose by summoning the inhabitants of the city to hear the reading of the Declaration Each year thereafter, it brought the people together to celebrate the anniversary of the Declaration, until in 1835 it cracked while tolling for the funeral of John Marshall, the celebrated chief justice of the Supreme Court

It has since remained in the hallway of the old State House of Philadelphia, an object of veneration It was lightly struck by officers of the city on April 6, 1917, when the United States entered the war with Germany

Today the engrossed copy of the Declaration faded and almost illegible, is kept in a shrine of glass and marble in the Library of Congress

*Text of the Declaration of Independence**

In CONGRESS, July 4, 1776

The unanimous Declaration of the thirteen united States of America,

WHEN in the Course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation ——We hold these truths to be self evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life Liberty and the pursuit of Happiness ——*That to secure these rights*, Governments are instituted among Men, deriving their just powers from the consent of the governed ——That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness Prudence, indeed will dictate that Governments long established should not be changed for light and transient causes and accordingly all experience hath shewn, that mankind are more disposed to suffer, while evils are sufferable than to right themselves by abolishing the forms to which they are *accustomed But when a long train of abuses and* usurpations, pursuing invariably the same Object evinces a design to reduce them under absolute Despotism, it is their right, it is their duty, to throw off such Government, and to provide new Guards for their future security ——Such has been the patient sufferance of these Colonies, and such is now the necessity which constrains them to alter their former Systems of Government The history of the present King of Great Britain is a history of repeated injuries and usurpations all having in direct object the establishment of an absolute Tyranny over these States To prove this, let Facts be submitted to a candid world ——He has refused his Assent to Laws, the most wholesome and necessary for the public good ——He has forbidden his Governors to pass Laws of immediate and pressing importance, unless suspended in their operation till his Assent should be obtained, and when so suspended, he has utterly neglected to attend to them ——He has refused to pass other Laws for the accommodation of large districts of people, unless these people would relinquish the right of Representation in the Legislature, a right in*estimable to them and formidable to tyrants only* —— He has called together legislative bodies at places unusual, uncomfortable, and distant from the depository of their public Records, for the sole purpose of fatiguing them into compliance with his measures ——He has dissolved Representative Houses repeatedly, for opposing with manly firmness his invasions on the rights of the people ——He has refused for a long time, after such dissolutions, to cause others to be elected, whereby the Legislative powers, incapable of Annihilation, have returned to the People at large for their exercise, the State remaining in the mean time exposed to all the dangers of invasion from without, and convulsions within ——He has endeavoured to prevent the population of these States for that purpose obstructing the Laws for Naturalization of Foreigners, refusing to pass others to encourage their migrations hither, and raising the conditions of new Appropriations of Lands ——He has obstructed the Administration of Justice, by refusing his Assent to Laws for establishing Judiciary powers ——He has made Judges dependent on his Will alone, for the tenure of their offices, and the amount and payment of their salaries ——He has erected a multitude of New Offices, and sent hither swarms of Officers to harass our people, and eat out their substance ——He

*This text follows exactly the spelling and punctuation of the original document

has kept among us, in times of peace, Standing Armies without the Consent of our legislatures.——He has affected to render the Military independent of and superior to the Civil power.——He has combined with others to subject us to a jurisdiction foreign to our constitution, and unacknowledged by our laws; giving his Assent to their Acts of pretended Legislation: —For quartering large bodies of armed troops among us:—For protecting them, by a mock Trial, from punishment for any Murders which they should commit on the Inhabitants of these States:—For cutting off our Trade with all parts of the world:—For imposing Taxes on us without our Consent:—For depriving us in many cases, of the benefits of Trial by Jury:—For transporting us beyond Seas to be tried for pretended offences:—For abolishing the free System of English Laws in a neighbouring Province, establishing therein an Arbitrary government, and enlarging its Boundaries so as to render it at once an example and fit instrument for introducing the same absolute rule into these Colonies:——For taking away our Charters, abolishing our most valuable Laws, and altering fundamentally the Forms of our Governments:—For suspending our own Legislatures and declaring themselves invested with power to legislate for us in all cases whatsoever.—He has abdicated Government here, by declaring us out of his Protection and waging War against us.——He has plundered our seas, ravaged our Coasts, burnt our towns, and destroyed the lives of our people.——He is at this time transporting large Armies of foreign Mercenaries to compleat the works of death, desolation and tyranny, already begun with circumstances of Cruelty & perfidy scarcely paralleled in the most barbarous ages, and totally unworthy the Head of a civilized nation.—— He has constrained our fellow Citizens taken Captive on the high Seas to bear Arms against their Country, to become the executioners of their friends and Brethren, or to fall themselves by their Hands.—— He has excited domestic insurrections amongst us, and has endeavoured to bring on the inhabitants of our frontiers, the merciless Indian Savages, whose known rule of warfare, is an undistinguished destruction of all ages, sexes and conditions. In every stage of these Oppressions We have Petitioned for Redress in the most humble terms: Our repeated Petitions have been answered only by repeated injury. A Prince, whose character is thus marked by every act which may define a Tyrant, is unfit to be the ruler of a free people. Nor have We been wanting in attentions to our Brittish brethren. We have warned them from time to time of attempts by their legislature to extend an unwarrantable jurisdiction over us. We have reminded them of the circumstances of our emigration and settlement here. We have appealed to their native justice and magnanimity, and we have conjured them by the ties of our common kindred to disavow these usurpations, which, would inevitably interrupt our connections and correspondence They too have been deaf to the voice of justice and of consanguinity. We must, therefore, acquiesce in the necessity, which denounces our Separation, and hold them, as we hold the rest of mankind, Enemies in War, in Peace Friends.——

We, therefore, the Representatives of the united States of America, in General Congress, Assembled, appealing to the Supreme Judge of the world for the rectitude of our intentions, do, in the Name, and by Authority of the good People of these Colonies, solemnly publish and declare, That these United Colonies are, and of Right ought to be Free and Independent States; that they are Absolved from all Allegiance to the British Crown, and that all political connection between them and the State of Great Britain, is and ought to be totally dissolved; and that as Free and Independent States, they have full Power to levy War, conclude Peace, contract Alliances, establish Commerce, and to do all other Acts and Things which Independent States may of right do.——And for the support of this Declaration, with a firm reliance on the protection of divine Providence, we mutually pledge to each other our Lives, our Fortunes and our sacred Honor.

(Georgia)
Button Gwinnett
Lyman Hall
George Walton

(North Carolina)
William Hooper
Joseph Hewes
John Penn

(South Carolina)
Edward Rutledge
Thomas Heyward, Jr.
Thomas Lynch, Jr.
Arthur Middleton

(Massachusetts)
John Hancock

(Maryland)
Samuel Chase
William Paca
Thomas Stone
Charles Carroll of Carrollton

(Virginia)
George Wythe
Richard Henry Lee
Thomas Jefferson
Benjamin Harrison
Thomas Nelson, Jr.
Francis Lightfoot Lee
Carter Braxton

(Pennsylvania)
Robert Morris
Benjamin Rush
Benjamin Franklin
John Morton
George Clymer
James Smith
George Taylor
James Wilson
George Ross

(Delaware)
Caesar Rodney
George Read
Thomas McKean

(New York)
William Floyd
Philip Livingston
Francis Lewis
Lewis Morris

(New Jersey)
Richard Stockton
John Witherspoon
Francis Hopkinson
John Hart
Abraham Clark

(New Hampshire)
Josiah Bartlett

(Connecticut)
William Whipple

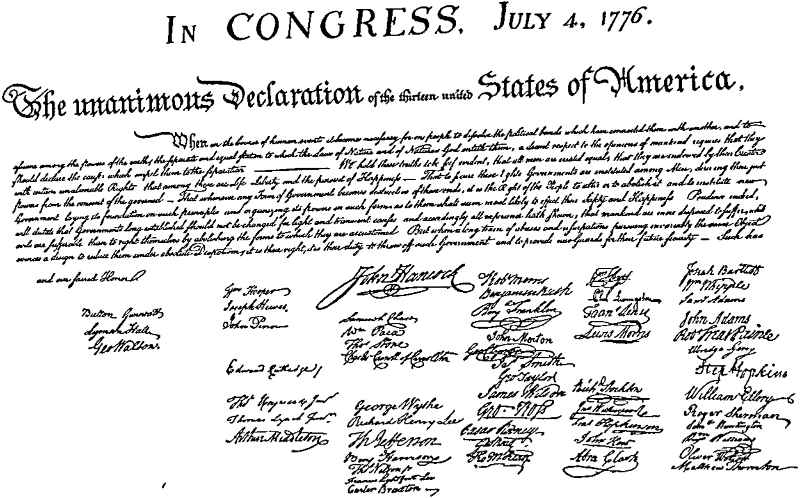
(Massachusetts)
Samuel Adams
John Adams
Robert Treat Paine
Elbridge Gerry

(Rhode Island)
Stephen Hopkins
William Ellery

(Connecticut)
Roger Sherman
Samuel Huntington
William Williams
Oliver Wolcott

(New Hampshire)
Matthew Thornton

These are the 56 men who signed the Declaration of Independence and the states they represented. Their actual signatures are shown on the opposite page. John Hancock, then president of the Congress, signed July 4. Most of the others signed August 2.



IN CONGRESS, JULY 4, 1776.

The unanimous Declaration of the thirteen united States of America,

When in the Course of human events it becomes necessary for one people to dissolve the political bands which have connected them with another, and to
assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they
should declare the causes which impel them to the separation. —— We hold these truths to be self evident, that all men are created equal, that they are endowed by their Creator
with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. — That to secure these rights, Governments are instituted among Men, deriving their just
powers from the consent of the governed, — That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new
Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness. Prudence, indeed,
will dictate that Governments long established should not be changed for light and transient causes; and accordingly all experience hath shewn, that mankind are more disposed to suffer, while
evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed. But when a long train of abuses and usurpations, pursuing invariably the same Object
evinces a design to reduce them under absolute Despotism, it is their right, it is their duty, to throw off such Government, and to provide new Guards for their future security. — Such has

and our sacred Honor

John Hancock

Button Gwinnett
Lyman Hall
Geo Walton.

Wm Hooper
Joseph Hewes,
John Penn

Edward Rutledge 1

Thos Heyward Junr.
Thomas Lynch Junr.
Arthur Middleton

Samuel Chase
Wm Paca
Thos Stone
Charles Carroll of Carrollton

George Wythe
Richard Henry Lee
Th Jefferson
Benja Harrison
Thos Nelson jr.
Francis Lightfoot Lee
Carter Braxton

Robt Morris
Benjamin Rush
Benja Franklin
John Morton
Geo Clymer
Jas Smith
Geo Taylor
James Wilson
Geo. Ross
Caesar Rodney
Geo Read
Thos M:Kean

Wm Floyd
Phil. Livingston
Frans Lewis
Lewis Morris
Richd Stockton
Jno Witherspoon
Fras Hopkinson
John Hart
Abra Clark

Josiah Bartlett
Wm Whipple
Saml Adams
John Adams
Robt Treat Paine
Elbridge Gerry
Step Hopkins
William Ellery
Roger Sherman
Saml Huntington
Wm Williams
Oliver Wolcott
Matthew Thornton

At the top are the first ten lines of the Declaration of Independence as it was written At the bottom are the actual signatures (see facing page for names by states)

How NATIONS *Honor Heroes of* PEACE *and* WAR

DECORATIONS AND TITLES OF HONOR. Deeds of great bravery on the field of battle have been rewarded since early times. As far back as the 2d century B.C., Jonathan, the Maccabean, was awarded a golden button for successfully leading the Jews in battle against the Syrian army. Gold buttons and gold medals were among the first decorations used to honor heroic war service.

The first English war medal was made in 1480. During the 19th century other nations began to devise decorations to bestow on war heroes. Today all great nations reward special valor and patriotic service with decorations of honor. Many of these awards may be won in peace as well as in war.

The Highly Prized Medal of Honor

In the United States the highest award for valor is the Medal of Honor. Because it is given by the president in the name of Congress, it is often called the "Congressional Medal." Army, Navy, and Air Force medals have separate designs but the rules governing the award are the same.

The Medal of Honor is given to anyone in the armed services who "in action involving actual conflict with an enemy, distinguishes himself conspicuously by gallantry and intrepidity, at the risk of his life *above and beyond the call of duty*." That last phrase disqualifies all acts of courage, no matter how great, performed in the course of carrying out orders or as a part of a man's service duties. In time of war the president may confer upon the highest commanders in the field the power to award this medal. Congress may also vote a Medal of Honor to persons not ordinarily eligible, as the award to Charles Lindbergh for his pioneer flight to Paris. Ranking just below the Medal of Honor is the Marine Corps Brevet Medal, given for distinguished service in the presence of the enemy.

Other Decorations for Valor and Achievement

The next highest decorations for valor are the Navy Cross and the Distinguished Service Cross of the Army and Air Force. These medals are of equal rank and are given for "extraordinary heroism in connection with military operations against an armed enemy." Next in rank is the Distinguished Service Medal, given by the Army, Navy, and Air Force for "exceptionally meritorious service in a duty of great responsibility." This is a reward for men in administrative posts in peace as well as in war. It is the highest noncombat decoration.

The fourth ranking medal is the Silver Star, awarded by all three services for gallantry in action. Next in importance is the Legion of Merit. This is awarded for meritorious conduct in the performance of outstanding services. Army, Navy, and Air Force men are eligible, as well as members of the armed forces of friendly foreign nations.

The Soldier's Medal (also given to airmen) and the Navy and Marine Corps Medal are both presented for heroism not involving actual conflict with an enemy. The Bronze Star Medal is awarded to all servicemen except airmen for heroic or meritorious achievement "in combat against the armed enemy."

Air Force, Navy, or Marine aviators may receive either of two medals. The Distinguished Flying Cross, ranking just below the Legion of Merit, is awarded for heroism or extraordinary achievement in aerial flight. The Air Medal, ranked just below the Bronze Star, is given for "meritorious achievement."

All services award a green and white Commendation Ribbon to officers and enlisted men. It is awarded for proficiency in carrying out a particularly difficult noncombat assignment.

The oldest decoration is the Purple Heart, founded by George Washington in 1782. Formerly it was given for "singularly meritorious acts," but the award now goes to all those who have been wounded as a result of enemy action. All services award a Good Conduct Medal to enlisted men who honorably complete a specified period of active duty.

Prior to 1949 enlisted men received $2.00 a month additional pay for most of these decorations. Servicemen wear medals only on occasions of full-dress ceremony. At other times the decorations are represented by rosettes or service ribbons worn in order of precedence on the left breast. If the same award is merited a second time, the Army and Air Force give an Oak Leaf Cluster; the Navy, a Gold Star. This cluster or star is worn on the ribbon of the original decoration. In case of posthumous award, presentation is made to the next of kin.

American Service Medals Before 1941

In addition to decorations of honor, the United States, prior to its entry into the second World War, issued Service Medals to all qualified officers and enlisted men. These medals were awarded to all military personnel who had taken part in specified campaigns or during the emergency period the medals represent. The following awards were earned by honorable service only:

Army Service Medals—Civil War, Indian Campaign, Spanish Campaign, Spanish War (noncombat service), Cuban Occupation, Puerto Rican Occupation, Philippine Campaign, Philippines Congressional (McKinley) Medal, China Campaign, Cuban Pacification, Mexican Service, Mexican Border, Victory Medal (first World War), and Army of Occupation of Germany.

Navy and Marine Corps Medals—Civil War, Expeditionary Medals (initial award 1874), Spanish Campaign, Philippine Campaign, China Relief Expedition, Cuban Pacification, Nicaraguan Campaign, Mexican Service, Haitian Campaign (1915), Dominican Campaign, Victory Medal (first World War), Army of Occupation of Germany, Haitian Campaign (1919–20), Second Nicaraguan Campaign, Yangtze Service, and China Service.

The Victory Medal was awarded to all who served in the first World War and in later campaigns in Russia and Siberia. Battle clasps worn on the ribbon of the Medal were awarded to those who took part in one or several of 19 specified engagements. Those who saw service abroad but not in the front lines earned a clasp naming the country where they served. Similar clasps indicated the nature of naval service performed.

The *fourragère*, a braided cord worn about the left shoulder, was awarded to units of the American Army cited by the French for distinctive service

Awards Given for the Second World War

When American forces began to fight in the second World War, additional campaign medals were authorized These were awarded to members of the land, air, and naval forces who served in the three large theaters of operation—American European African Middle East and Asiatic Pacific Small bronze stars on a theater ribbon indicated participation in battles within the area A silver battle star was worn to represent five bronze stars Service in a beachhead battle or invasion was indicated by a small bronze arrowhead Similar decorations were awarded to members of the Coast Guard and Merchant Marine

Three additional campaign ribbons were created by the Philippine government These were awarded American fighting men for Philippine Defense 1941–42 Philippine *Liberation 1944–45 and Philippine* Independence 1945–46

Three special medals were awarded during the second World War the American Defense Service Medal to all who served some period between Sept 8 1939 and Dec 7 1941 the World War II Victory Medal to all members of the armed forces who served between Dec 7 1941 and Dec 31 1946 and the Army of Occupation Medal to those who served at least 30 days in the occupation armies

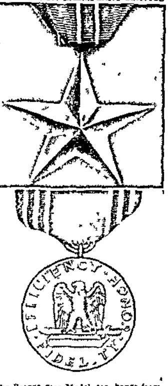
New medals were created for service *in the cold war The Humane* Action Medal was awarded for work in the Berlin airlift 1948–49 Members of the armed forces who served in Korea between June 27 1950 and July 27 1954 were given two medals—the Korean and the United Nations Major battles were represented on the blue and white Korean ribbon by bronze stars Beginning in 1953 the National Defense Medal was given for honorable service after June 27 1950

Badges Awarded for Skill and Courage

During the second World War and after foot soldiers earned the Expert Infantryman Badge by attaining certain standards of proficiency established by the Army The Combat Infantryman Badge was awarded for exemplary conduct in action against the enemy *Members of the Medical Corps* attached to infantry units received the Medical Badge for services during combat operations Additional badges were awarded for diving duty glider service parachute jumps and other hazardous duties Beginning in 1951 combat infantrymen and medical personnel could add a small silver star to their badges for service in Korea

Additional pay for all these badges was abolished in 1949 Personnel now engaged in duties involving extra hazard are rewarded with special 'incentive pay (*see* Army) Other medals and badges are awarded for excellent marksmanship with small arms (rifle and pistol) and automatic weapons

MEDALS FOR EXEMPLARY SERVICE



The Bronze Star Medal top hangs from a red white and blue ribbon. It is awarded by all services for heroic or meritorious achievement Bottom, the Good Conduct Medal with a red and white ribbon is for honorable enlisted service

Awards to Units and Civilians

In addition to decorations awarded *to individuals recognition was* also given to Army and Navy organizations that served with distinction in combat The Army Distinguished Unit Citation went to units which were cited for outstanding performance of duty in action against an enemy The Navy awarded the Presidential Unit Citation to ships aircraft and naval or Marine units for outstanding performance in action on or after Oct 16 1941 ' Members of units twice cited were authorized to wear a citation ribbon with an Oak Leaf *Cluster (or Gold Star) on the right* breast of the uniform

After the proclamation of a national emergency on Sept 8 1939 the President authorized two decorations for civilians of the United States and friendly foreign nations The Medal for Merit was awarded for exceptionally meritorious conduct in the performance of outstanding services The Medal of Freedom with degree went to those who distinguish themselves by meritorious achievement or meritorious service to the United States in the prosecution of the war against an enemy The degrees, ranked from high to low in order of precedence, are Gold Palm Silver Palm and Bronze Palm The Medal without degree is equal to the Bronze Star Medal

Three other civilian awards created during the second World War went to the men and ships of the Merchant Marine They were the Merchant Marine Distinguished Service Medal, the Combat Bar, and the Gallant Ship award

Britain s Victoria Cross

The highest honor a British fighting man can win is the Victoria Cross established by Queen Victoria in 1856 It may be awarded to men of all ranks in the army and navy but only for a signal act of conspicuous bravery in the presence of the enemy From 1912 to 1947 native officers and men of the Indian army were eligible So high is the standard set for the V C as it is called that during its first 50 years less than 600 were issued

The Distinguished Service Order (D.S.O.) is given to British army and navy officers for conspicuous merit in time of war, including heroism under fire or other important services in the field. It was founded in 1886. It illustrates a type of distinction in which the receiver of the award becomes a member of an honorary *order*, or society. The Distinguished Conduct Medal, given to noncommissioned officers and men in the ranks, corresponds to the D.S.O. of commissioned officers.

In the second World War, Canada established an award of its own, called the Canada Medal. This was given to civilians and members of the armed forces "for meritorious service above and beyond the faithful performance of duties."

Several British decorations were created during the first World War: the Military Cross, for commissioned and warrant officers below the rank of major; the Military Medal, for noncommissioned officers and civilians for acts of bravery in the field; the Distinguished Service Cross and the Distinguished Service Medal, both naval decorations.

France's Legion of Honor

Membership in the French Legion of Honor, one of the most famous of all distinctions, is awarded for meritorious service to France in military or civil life. A scientist may receive the decoration for some valuable discovery, or a soldier for an act of conspicuous bravery. The order was founded by Napoleon in 1802. Membership may be conferred upon foreigners as well as Frenchmen, and upon women as well as men. The French Croix de Guerre, established during the first World War, and the Médaille Militaire, founded by Napoleon III, are the two most noted decorations for purely military services.

Decorations of Other Countries

Germany's highest military decorations are the Order for Merit (*Ordre pour le Mérite*), instituted in 1665, and the Iron Cross, instituted in 1813. The Iron Cross was so freely bestowed during the first World War that it lost some of its value. But during the second World War the Nazi government restored it as a mark of extraordinary military distinction.

The chief Italian decoration is the Military Order of Savoy. In Belgium the highest distinctions are the Order of Leopold and the Military Cross. Japan's highest military decoration is the Order of the Golden Kite. Two of the principal awards given by Russia to its military heroes are the Order of Suvorov medal and the title of "Hero of the Soviet Union."

Awards to Groups of Heroes and to Civilians

Occasionally the heroism of whole groups of fighting men is commemorated. In the second World War, 161 survivors of the United States cruiser *Helena*, sunk by the Japanese, were honored for their gallant fight against the enemy. For the first time in American naval history the ship too received a unit citation. Later a United States merchant vessel—the Liberty ship *Samuel Parker*—was presented a Gallant Ship Award. The ship had been in heavy action in the Mediterranean for six months of 1943 and had survived repeated bombing attacks during the invasion of Sicily. Also during this war an entire division of American air-borne troops (the 82d) received the Presidential unit citation for gallantry in action. And the Russian army was awarded the Sword of Stalingrad by the British populace.

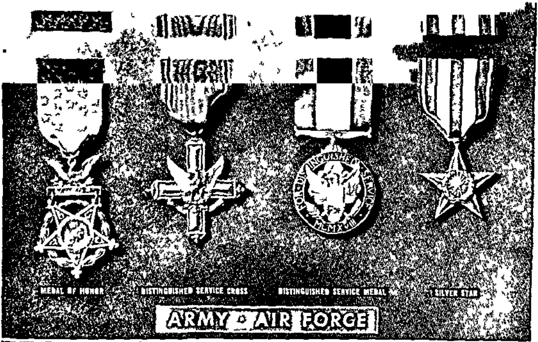
Civilian heroism also is rewarded, both in wartime and peace. Britain's George Medal is given to civilians for conspicuous bravery during enemy attacks. In the United States the Carnegie hero medal is given to people who display unusual bravery in saving or attempting to save human life. Even animals are rewarded for their brave acts; a United States War Department ruling permits the awarding of a citation to war dogs that perform meritorious service.

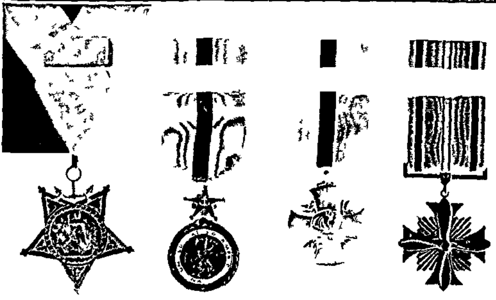
Titles of Nobility and What They Stand For

TITLES of nobility date back to feudal days, but they do not mean the same as they did then. Today they indicate the social rank of a person whereas in the old days of knights and ladies, they were the marks of responsibility. The man who had a title had duties to perform, and held his rank in court because of that. (*See* Feudalism.)

At first the only titles were count and duke. "Count" comes from the Latin word *comes* which means a companion of the king. "Duke" comes from the Latin word *dux*, a leader. The dukes were in charge of sections of the country or parts of the army, and had to lead their armies in battle. The counts were the chiefs of sections of the country, such as provinces in France or counties in England. These titles came to mean the right to rule a part of the country, and they were hereditary, passing from father to son. Thus they became titles of nobility. "Comes" and "dux" (the Latin forms of these words) were used by Charlemagne. When his empire broke up, the titles survived in different parts of Europe, finally in France becoming "comte" and "duc" and in Germany "graf."

When the Normans conquered England, they divided the country and entrusted the administration of the counties to "earls," who were of the same rank as continental "counts," and their wives were called "countesses." Under the earls were the men who had smaller grants, but ranked above their knights. At first all the nobility were called "barons," which meant "men of quality." Later it became the specific title of the lesser nobility. To give princes and relatives of the king a higher rank than the earls, King Edward III in 1337 created the title of "duke," to rank above that of "earl," by making Edward, the Black Prince, the Duke of Cornwall. Today the highest rank of nobility next to the king or queen and the royal princes is that of duke. Now there are few English dukes not of royal blood. Occasionally there are exceptions, such as the Duke of Wellington,





MEDAL OF HONOR | DISTINGUISHED SERVICE MEDAL | NAVY CROSS | DISTINGUISHED FLYING CROSS

NAVY

See text on pages 39 and 40

By courtesy of Life Magazine

UNITED STATES DECORATIONS OF HONOR

whose ancestor won his high rank by achieving brilliant military victories.

Titles of Peers and Others

The frontiers or "marches" of the feudal kingdoms were often attacked by an enemy, and the head of such a district was called a "marquis" or "marquess." The first marquis in England was created in 1385, and was given a rank between that of duke and earl. Then between the earls and the barons were created "viscounts" (meaning *vice-counts*); the first was created in 1440. All these titles were given to the heads of districts and the holders of great estates. Under them were the knights and their squires (*see* Knighthood). The knights were not of the peerage (nobility), and their rank was not hereditary. In 1611 King James I created from the landed gentry an order of hereditary knights called "baronets." These hereditary knights rank between barons and knights and add after their names the abbreviation "bart."

The term "esquire," at first applied to the young man who bore the knight's shield and lance, has so far lost its original significance that nowadays it is given by courtesy to anyone called a gentleman.

In the United States, the word "mister" or "master" is used for every male. Originally, however, it was the title of a gentleman, a rank between the squires and the ordinary people. Mister (master), like *herr* in Germany, and *monsieur* (my lord) in France, has come to be used indiscriminately when addressing a man in a polite way.

Differences in English and Other Titles

While in England titles have a definite relationship to each other, this is not true everywhere Many little states that grew up in Europe were absorbed in empires and separated again until there were many rulers of independent countries who could bestow titles. In France certain of the lesser titles could be taken by landed proprietors. Also, in Europe, the title was a family honor, not a personal honor. In England only the oldest son could inherit the title, according to the law of primogeniture; but in many European countries all sons of a count, for example, were also called counts.

In France all titles were abolished after the Revolution. Then Napoleon I created a great many new titles, and Louis XVIII, after his restoration, added many more; in addition all the old titles were revived, while those given by Napoleon were retained. The revolution of 1848 again forbade titles, but Napoleon III created new ones, and old ones were again revived. When France finally became a republic in 1870, titles were not even mentioned in the constitution, and today are held as a courtesy.

Titles for Sons of Noblemen

Courtesy titles are also found in England, where sons of the three highest ranks of nobility are always given a title below that of their father. Thus the eldest son of a marquis is usually referred to as an earl, and given one of the minor titles which is actually held by his father; legally, he is only a commoner. Younger sons of a marquis are called viscount. The present Duke of Wellington has among others two titles of marquis, two of earl, two of viscount, and two of baron, besides his Spanish, Portuguese, and Dutch titles. His eldest son, therefore, is called Marquis Duro, and his grandson is called the Earl of Mornington.

Strictly speaking, titles are not personal property. The lands (and the titles and duties that went with them) were first granted by a king at his pleasure, and could be taken back by him. So titles can be lost and revert to the king, when the line dies out, or because of some crime committed by the holder. Where democracies have succeeded kings, the legislatures often have abolished titles. The Constitution of the United States (Art. 1, Sec. 9) says that no title of nobility shall be granted by the United States, and persons in the government service are prohibited from accepting honors from foreign countries without the consent of Congress. Also, persons who wish to become naturalized citizens are required to drop all titles they may have held in their native lands.

How British Titles Rank

For men, the order of precedence among the British nobility runs thus: king, dukes of royal blood, other dukes, marquises, eldest sons of dukes (marquises by courtesy), earls, eldest sons of marquises (earls by courtesy), younger sons of dukes (earls by courtesy), viscounts, barons of the nobility, baronets, knights of various grades, esquires, and gentlemen ranking below the peerage. Within each group there is a careful ranking of individuals depending on the date the title was created, and whether it is English British, Scottish, or Irish.

Precedence in a democracy such as the United States is based upon the position which the individual holds in the nation's government. Thus, in official Washington there is fairly well-defined precedence—the president, vice-president, ambassadors, justices, ministers, speaker of the house, cabinet members, senators, etc.

In Great Britain the proper form of address in conversing with the nobility is somewhat confusing Knights are always called Sir, but if Mr. Richard Johnson is made a knight, he is not called Sir Johnson, but instead Sir Richard, or Sir Richard Johnson. This is because when knights were first created, people did not have family names. Titles of nobility are distinct from the actual name of the holder, so if Sir Richard Johnson is made a baron he keeps his family name, although he may take a new title, such as Baron of Aarondale. He is then addressed as Lord Aarondale. Dukes and duchesses are always addressed as such, but the other nobles, including those by courtesy only, are addressed as Lord or Lady Younger sons of earls, and sons of viscounts and barons (these do not have courtesy titles) are addressed as Honorable (Hon.), but use the given name and the family name, not the title.

Addressing British women is even more complicated Men hold titles for themselves, but women may rank only because their father held a title or because they

married a man with a title or were themselves given a rank A lady who has that title because of birth (the daughter of a duke marquis or earl) uses it with her given name as Lady Alice, but if she acquires it by marriage she uses it with her husband s name Thus a knight or a baronet may be Sir Richard while his wife is known as Lady Johnson The rank of dame is the feminine equivalent of knighthood It is applied not only to the wives and widows of knights and baronets but is conferred as a title as for example Dame of the Order of the British Empire

The heads of the Church of England the Archbishop of Canterbury and the Arch bishop of York and a certain number of bish ops are members of the House of Lords and rank as members of the Brit sh peerage or dinary bishops rank just above barons Cardinals of the Roman Catholic church are called princes of the church and many priests who are not b shops are granted the title monsignor which is equivalent to my lord The pope also may confer the t tle of count on lay persons The Golden Rose consecrated by the pope and conferred on some distinguished individual church or community is an honor of the highest rank (*see* Crusading Orders)

A MULE DEER STOPS LOOKS AND LISTENS

This is a fine specimen of the Cal fo nia mule deer photographed on a fo ested mountain slope of southern California The la ge ea s clea ly show why he is called a mu e dee His ant e s a e n the velvet, which d ops away befo e mating time in the fa l. California mule deer range f om southe n California into northern Lower California.

Orders of Knighthood

The rank of kn ghthood is frequently conferred by the Br tish sovereign today in recognition of special services in politics literature or science

Among the important Br tish o de s are these Order of the Garter established by *Edward III about* 1348, and con sisting ch efly of membe s of the royal family Its motto s *Hon soit qui mal y pense* (Evil be to him who evil thinks) membership s nd cated by the *letters* K G *after* the name the Order of the Th stle an ancient Scott sh order dating f om 1687 in t als K T Order of St Pat ck for Ireland created n 1788 n tials K P *Order of the* Bath founded n 1399 *three classes—Kn ghts of the Grand Cross* (G C B Kn ghts Commanders (K C B) and Compan ons (C B) Order of St M chael and St George created in 1818 *(G C M G K C M G and C M G) Other British orders* are the O der of the Sta of Ind a (G C S I etc) Order of the Ind an Emp re (*G C I E* etc) V ctorian Order (G C V O etc) and Order of the British Emp re

The chief orders of kn ghthood in other coun tr es are the Order of the Golden Fleece (Spa n and Austria) O der of the An nunz ata (Italy) Order of the Black Eagle and Order of the Red Eagle (Pruss a) and Order of the Chrysan themum and Order of the Rising Sun (Japan)

The papal orders of kn ghthood for d st n *guished laymen are (n the* order of the r mportance) the Sup eme Order of *Ch st Order of P us IX,* O der of St Gregory the Great Orde of St Sylvester Order of the Go den Mil t a or Golden Spur and Order of the Holy Sepulchre

Many m nor orders given by var ous European count es are merely hono ab e dist nct ons and confer no t t e or preced ence Examples of these in Eng and a e the Order of Mer t and the Com pan ons of Honour

Other honors are conferred by un ver s t es and learned so c et es throughout the wor d Un ers ties g ve honorary degrees for outstand ng work in al most any f eld of en deavor Learned societies such as the French Academy the Royal So c ety (Br tish) and the Amer can Academy of *Arts and Letters recog n ze d st ngu shed ach evement by nv tat ons to membersh p* and by medals and prizes

DEER Of all the wild animals of North Amer ca the best friend of the early pioneers was the white-tailed deer Its flesh (venison) formed their main food—*indeed it saved their lives when crops failed* and from its h de they cut their sturdy buckskin jackets breeches and moccasins as the Indians had done for centur es

The deer family includes about 60 species ranging in size from the huge *Alaska* moose down *to the* Chilean pudu wh ch is almost as small as a rabbit *The best known of the larger species*—the moose the elk the caribou and the reindeer—are described in separate articles Here we shall d scuss other spe-

cies that are especially interesting or useful.

Life and Habits of the Whitetail

The white-tailed, or Virginia, deer still abounds in northern Michigan, Wisconsin, Minnesota, and Canada; and smaller whitetails are found in some of the Southern states. The northern whitetail male (called a buck, or stag) weighs up to 300 pounds and stands three and one-half feet high at the shoulder. From the buck's antlers, which curve forward, rise five or six unforked tines. The female (doe) is smaller and has no horns.

Whitetails are reddish brown in summer and gray in winter. Their bellies and the undersides of their tails are white. When they run, they lift their tails straight up like white flags. The young fawns have reddish coats spotted with white.

A young buck in his second year develops his first pair of spikelike antlers. Each spring he sheds them and a larger set grows in. By his sixth year his antlers are fully grown and do not change much after the annual shedding (*see* Horn). His average span of life is ten years. A buck can gallop three or four miles at a speed of 25 miles an hour.

Whitetails browse on grass, leaves, acorns, nuts, and water plants. They enjoy long swims at sundown. In winter they trample the snow to form "yards," in which they huddle for protection. They eat dried grass and moss from the bared patches.

The autumn mating season transforms timid bucks into fierce fighters. With eyes bloodshot and necks puffed out, they rush together head-on, struggling until one of them is driven off, leaving the does of the herd to the victor. Sometimes their antlers lock tight and two bucks die together.

Deer of Western North America

In the western mountains of North America lives the *mule deer*, which has ears nine inches long. The buck weighs 150 to 200 pounds, and has forked tines on his antlers. The mule deer is rusty brown in summer and gray in winter. He has a white tail tipped with black; and he holds it down when running. He runs stiff legged, bounds high over rocks and gullies, and lands on all fours.

The *Columbian blacktailed deer* lives in moist forests along the Pacific coast. He has a black tail (white underneath), which he holds straight out when he runs. His antlers resemble those of the mule deer.

Deer in Central and South America

Through grasslands from southern Mexico to Paraguay steal the *brown brockets*. They are only one and one-half feet tall, and the bucks fight with spike antlers less than five inches long. The larger *red brockets* (two and one-half feet tall) live in the jungles.

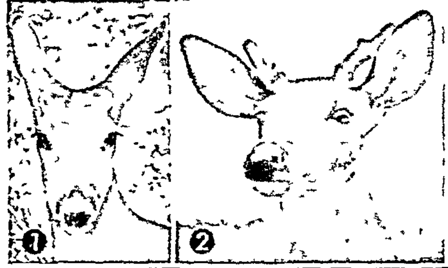
The *Chilean pudus*—the smallest deer in the world—are about a foot high and have spike horns. High up in the Andes roam the gray, heavy-bodied *guemals* (or *huemals*). They are somewhat smaller than the average whitetail and have curious Y-shaped antlers, forked near the base.

In the wet lowlands of eastern South America are found large *marsh deer*, four feet tall. They have a peculiar rocking run and travel easily over swamps that mire their pursuers. Their antlers resemble the mule deer's. The reddish-brown *pampas deer* stand only two and one-half feet high. Hunters can smell them a mile away, for they exude a strong scent from sacs in the hind feet.

European Deer

The *red deer*, famed in the stories of Robin Hood, ranges through Europe and into Iran and northwest Africa. It is distinguished by a long fringe of hair at its throat. The hart (stag) stands about four

HOW A DEER RENEWS ITS ANTLERS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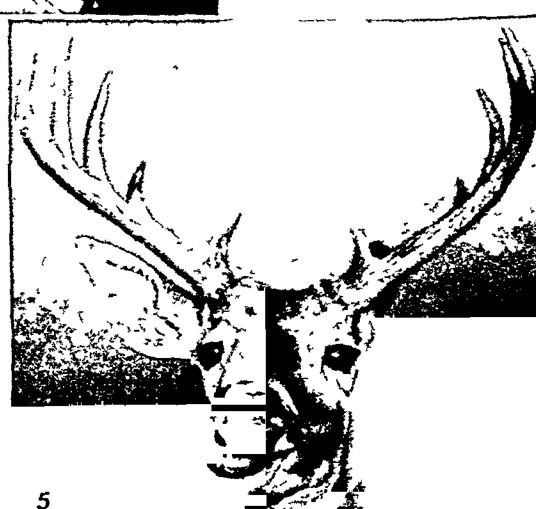
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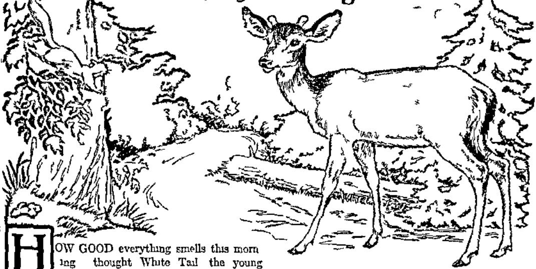
1. This white-tailed buck in the spring has shed its last year's antlers The new ones are merely bumps at the base of the ears. Pictures 2 and 3 show the growing antlers coated with "velvet," a fuzzy skin that covers and nourishes them while they are still soft. 4. The velvet begins to rub off in the fall. Here it hangs in ragged strips about the ears. 5. All the velvet is gone, and the winter fighting antlers have reached their full growth and hardness.

WHITE TAIL *and the* OLD STAG'S LESSON

The Story of a Young Deer



What a fine fellow sa d the Squ rrel

"HOW GOOD everything smells this morning thought White Tail the young deer as he went along a forest pathway It was a fine morning late in summer and White Tail was on his way to a near by stream to breakfast on the rushes and water weeds that grew there His small pointed hoofs made scarcely a sound as he walked and his long ears were pointed forward alert and li ten ng Those ears caught every small sound and warned him of danger while it was yet a long way off

Though the sun had just risen many of the fo e t creatures were already abroad They looked at h m admiringly He was a hand ome young deer with his slim legs and his r ch brown summer coat that glistened almost red where the sun reached it

Good morning White Tail a squ rrel called out from a tree What a fine fellow you are growing to be!

Thank you Squirrel White Tail answered I have grown a good b t haven t I?

Indeed you have said the squirrel Why last year you were only a little fawn You couldn t go anywhere without your mother

Yes White Tail answered qu ckly I used to be afraid to leave her But now I go about alone when ever I like

Well don t let it make you too proud or you will get into trouble sa d the squirrel as it whisked down the tree and scampered away

White Tail was greatly plea ed that the squirrel had noticed ho v much he had grown and he held his small head high as he went along.

Presently as he stopped to nibble at a bush be de the path a pair of branching antlers was suddenly lifted and there stood an old stag looking r ght into his eyes

Excuse me the young deer said politely I d dn t know you were feeding here I am White Tail and I only wanted to eat a few leaves from this bush I didn t mean to startle you

You d dn t startle me the old stag sa d I knew you were coming I heard a squirrel chattering with you and once I heard you paw the ground when you stopped to bro se

White Tail was ashamed at the old stag s words for he knew that one of the first things a young deer should learn was to pass through the forest without making any no se I will be more careful next time he thought Then looking curiously at the old stag he asked Aren t you a stranger here? I don t remember see ng you before

Yes I am a stranger the old stag told him and I have come from a great distance I wonder if you could tell me where I can find some salt he went on I do not know the country around here and I am hungry for salt

Yes sir White Tail answered I know where there is plenty of salt If you will come along with me I will show you

The two deer set off together through the forest At first White Tail felt a little shy but presently he

ventured to say, "What a fine pair of antlers you have, Old Stag! I never saw such huge ones before."

"There are plenty of antlers as large as mine," the old stag told him. "Some are even larger. But my antlers have served me well in many a fight."

White Tail felt a new respect for this old stag who had come from such a distance, and who spoke so quietly about the fights he had had. "I wish my antlers were large," he said. "It must be fine to have big antlers to fight with."

"A fine pair of antlers!"

The old stag looked at the two small spikes growing out of White Tail's head and he was a little amused at the young buck who was in such a hurry to grow up "You will have plenty of fights when you are older." he said, "but there are many things that you must learn before your antlers are ready to fight with."

"What things?" White Tail asked.

"Well," said the old stag "I noticed a moment ago that you stepped on a dead twig and snorted when it snapped under your feet You must learn to be quiet in the forest. You must not snort. You must not make any noise at all. For if you do, some day the Hunter will find you, and then you will be sorry!"

"It is," the old stag answered. "But there are times when I have no antlers. Did you know that, White Tail?"

"No," said White Tail, in amazement. "What happens to them?"

"Each year, in winter, they fall off," the old stag replied. "And then for a while I have no antlers at all."

"Will mine do that, too?" asked White Tail.

"Yes, your antlers will fall off in the winter, and new ones will grow again in the spring. For a long time after the antlers begin to grow, they are tender and easily hurt. So they have a soft, velvety covering to protect them. But when the time comes, we rub the covering off against a tree or bush, and then our antlers are fine and hard again, and we are ready to fight with them."

"I hope my antlers will soon be hard," White Tail said, "and then I will fight with them."

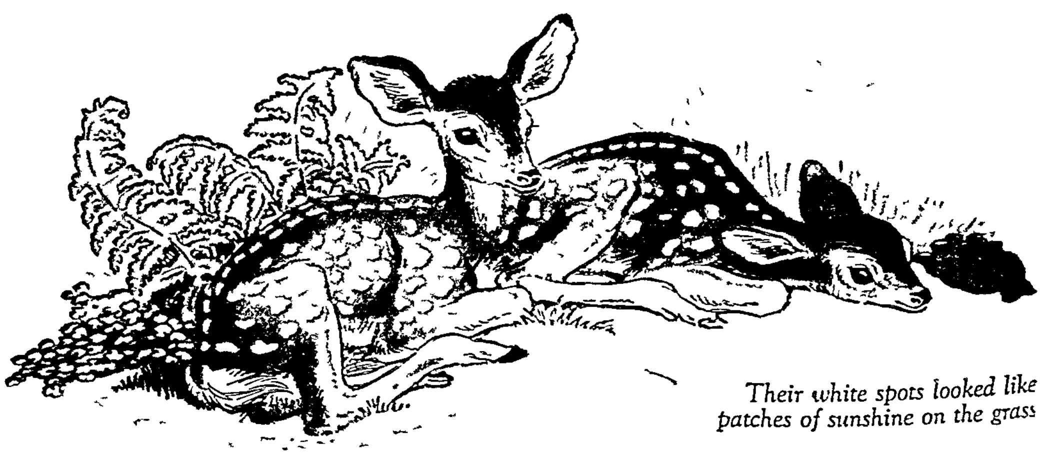
White Tail stopped in his tracks. "What is the Hunter?" he asked. "I do not know him."

"The Hunter is a danger," the old stag said. "He comes into the forest to look for us, and if he sees us, he tries to kill us."

"Tell me more about him," White Tail said anxiously. "Won't you?"

"No," replied the old stag, "I want to hurry along to that salt lick. You ask your mother. She will tell you all you need to know."

Now they had reached the edge of a shallow ravine White Tail turned from the path they had been following and led the way through dense underbrush out into a wide, well-beaten runway. "This is the road to the salt lick," he said. "We'll soon be there now."



Their white spots looked like patches of sunshine on the grass

The old stag had seen such paths before It has taken a long time to make a runway like this he said The feet of many deer have passed this way

Soon they were in a rocky glade where a number of other deer were eagerly licking the soft salty earth at the edge of a little stream White Tail and the old stag at once began to lick up the salt that tasted so good

After a little while the young deer raised his head and looked about him The old stag had not yet had his fill of salt so White Tail went over to some scrubby bushes and peeped through them At first he saw nothing to interest him but a moment later he caught sight of two small fawns on the ground not far away Pushing his way through the bushes he spoke to them

Hello little fawns! I didn t see you at first because the white spots on your bodies fooled me They look like patches of sunshine on the grass

Our mother says that is why we have these white spots one of the little fawns answered shyly They help to hide us from sight

I know White Tail said I had them too when I was as small as you But mine have gone now and yours will go before winter comes You will have another coat for winter It will be thick and warm and it will not be spotted

I don t want another coat said one of the little fawns I like my coat just as it is

Well White Tail replied you will have a dull brown coat for winter whether you want it or not

He ran his small head held high

All deer change their coats before winter gets here You have never seen a winter and you don t know what it is like It is a cold time and the deer live together in the forest Last winter the snow was piled so deep on the ground that we could not walk through it at all and we had to keep paths open everywhere I was hungry most of the time for there was nothing to eat except a few small berries and the young branches of trees and now and then a little dry grass and moss that we pawed up from under the snow

That seems very strange said the fawns We have always had all we wanted to eat We don t understand such things at all But we must not talk any more now Mother told us to keep very quiet until she came back to us

Where is your mother? White Tail asked

She is over at the salt lick but she will be back soon She never leaves us very long

Don t you wish you were big enough to go about alone the way I do? White Tail asked Watch me now! See how fast I can run!

He gave a leap into the air and ran a little distance his small head held high his short white tail erect Then he turned and ran back and this time he did not stop beside the little fawns but ran on into the rocky glade

Aren t you forgetting what I told you about keeping still? the old stag scolded him You run about making as much noise as though there were no such thing as a Hunter in all the world

I forgot White Tail said I only wanted to show the fawns how fast I could run

You mustn t be too proud or you will get into trouble said the old stag just as the squirrel had said earlier in the morning

I m sorry White Tail answered I ll try to remember next time

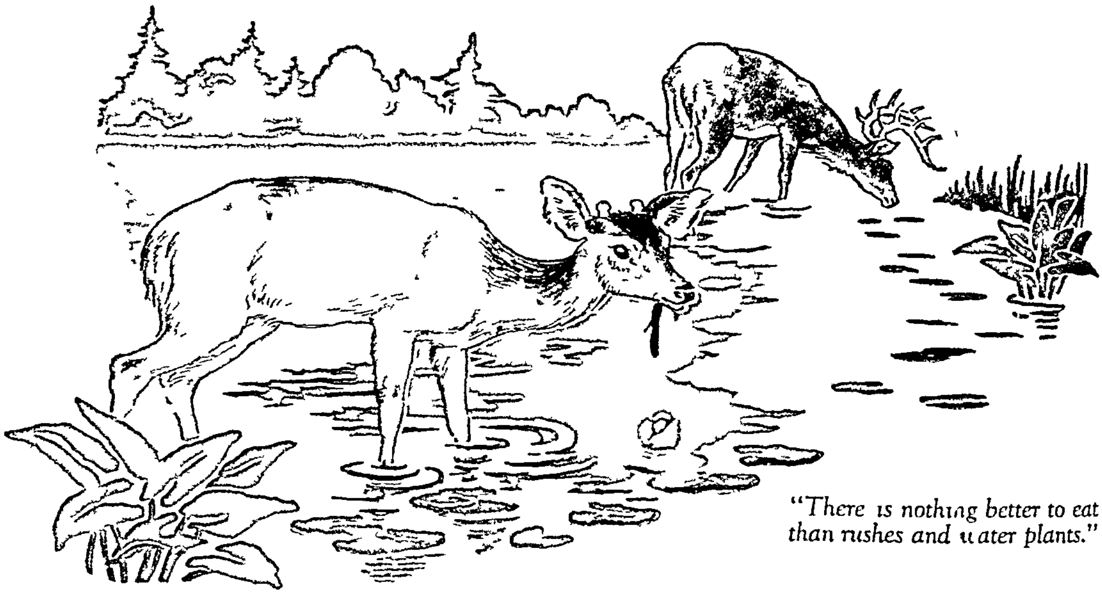
All right said the old stag And now suppose we look for something green to eat

I would like that White Tail told him I know a stream where water lilies and rushes grow Shall we go there now Old Stag?

Yes the old stag replied that will be fine There is nothing better to eat than rushes and water plants Besides he added the flies are beginning to bother me and I will be glad to splash about in the water for a while

When they reached the stream the two deer swam at once to the other side where the rushes grew thickest

White Tail liked to swim almost as well as he liked to run After they had eaten all they wanted of the fresh green leaves and the tender stems he swam about in the cool water while the old stag rested on



"There is nothing better to eat than rushes and water plants."

the shore and chewed his cud. The young deer would have liked to stay there all day. He was sorry when, by and by, it was time for them to return. "The sun is getting high," the old stag said, "and we are not safe out here. Night is the best time to come to the stream to eat."

Crossing to the other side, they made their way back along the forest path. They had not gone far when the old stag suddenly stopped and listened. "Keep very still, White Tail!" he whispered. "I hear the Hunter!"

In spite of the old stag's warning, White Tail took a few quick steps forward, as though he were about to run "Keep still!" the old stag repeated sharply. "He may see you if you move. The wind is blowing toward us, so I can smell him plainly. I can tell just where he is each moment. I will warn you if there is any need to run."

White Tail sniffed the air anxiously, and there came to his nostrils a strange new smell, a smell that he would never forget for the rest of his life.

In a moment the old stag whispered again. "Do you hear the cawing of the crows and the screaming of the jays? It is their warning to the forest creatures. They have seen the Hunter. Keep your head low behind the bushes, White Tail."

The young deer did as he was told. It seemed a long time that he stood there, trembling, not daring to move. "You can see him now, White Tail, if you peep through the bushes," the old stag said at last

White Tail had never seen a man before. At the first sight of the Hunter, coming down the hillside, he was so frightened that, in spite of all the old stag had said, he turned and ran as fast as he could. He did not stop until he reached the middle of the forest

For a long time he stood there, tired and panting. But though he strained his ears, he heard nothing, and he knew that for this time he was safe.

"I should not have run so soon," he said to himself. "The Hunter might have seen me."

Presently White Tail saw the old stag coming along the forest pathway. "I am sorry I ran, Old Stag," he said. "Are you very angry with me?"

"No, I would have done the same thing, at your age, I suppose. And I have seen older deer than you run from the Hunter. But the next time you see him, you must keep as quiet as you can, until you are sure which way he is going. Do not let him see you if you can help it, White Tail, for the Hunter is the greatest enemy we have. Always remember that."

"I will," White Tail promised. "Next time I won't forget a thing you have told me."

"I will not be with you the next time you see the Hunter," the old stag told him, "for I must be going on now. But you are a fine young buck and will soon know how to take care of yourself. I hope I will see you again some day."

Without another word, the old stag went off into the forest, his head held high and his long ears pointed forward, listening for danger. White Tail stood watching him until at last he disappeared from sight. Then he turned and went back the way he had come, thinking of the exciting story he had to tell his mother and the many questions he wanted to ask her.

WHITE-TAILED DEER—SYMBOLS OF THE UNSPOILED WILDERNESS

This museum group shows a typical family of white-tailed or Virginia deer in autumn. At the left a fawn holds its tail erect as do all white-tails when they are frightened or in flight. In the center of the group a doe reaches up for the leaves that these deer find so nourishing. At the right a lordly buck displays the antlers that he wields in duels for the does.

feet tall and has magnificent many-pointed antlers. At mating times he roars and fights fiercely.

The favorite of European hunters is the slender *roe deer*, which is found from the British Isles east to the Pacific Ocean. It stands only two feet high. At mating season the bucks pursue the does in circles, making trails called "doe rings."

The handsome *fallow deer*, about three feet high, lives in southern Europe and northwest Africa. Although domesticated in preserves for two thousand years, it has kept its wild habits. It has a white-spotted summer coat and flat mooselike antlers.

Some Interesting Deer of Asia

In the jungles of India and Ceylon lives the reddish *axis deer*, or *chital* (native for "spotted"), which keeps its white spots the year round. The buck stands three and one-half feet tall and has large antlers. Chitals scream loudly when alarmed.

Great brown *sambars* weighing up to 700 pounds roam the hills of northern India, and smaller sambars are found on the plains to the east and in the coastal islands. Sambars keep their massive antlers for several years between sheddings.

In many parts of India thrives the brown *Indian muntjac*, or *barking deer*, which barks like a dog when excited. The buck is 30 inches tall and has two-tined antlers about four inches long.

Through reedy marshes in northeastern China slips the *Chinese water deer*, about 30 inches high. Except for the perfume-giving musk deer, it is the only living deer that lacks antlers (*see* Musk Deer). Both sexes, however, have formidable tusks.

The brown *Japanese sika deer* carries stately antlers. On its rump is a patch of white hairs which flare out like a chrysanthemum when the animal is excited, serving as a guide for the herd.

The Strange Chevrotains, or Mouse Deer

In Ceylon and India we find the miniature *Indian chevrotain*—the so-called "mouse deer" (*Tragulus meminna*). It is not a true deer but belongs to a family of its own (*Tragulidae*). It stands less than a foot high. Like a musk deer, it has tusks instead of antlers, like a pig it has four toes on each foot, and like a camel it has three stomach compartments instead of the deer's four. Its cousins, *water chevrotains* (*Dorcatherium aquaticum*), are found across equatorial Africa.

Natural Relationships of the Deer

Deer belong to the family *Cervidae* of the order *Artiodactyla* (even-toed hoofed mammals). The *Cervidae* are related to the *Bovidae* (cattle, antelopes, sheep, and goats) and are like them in chewing the cud (*see* Ruminants). They differ in having *solid* horns which they shed periodically. Except for reindeer and caribou, only male deer have horns.

The scientific name of the white-tailed or Virginia deer, *Odocoileus virginianus*; mule deer, *Odocoileus hemionus*; Columbian black-tailed deer, *Odocoileus columbianus*.

DEFOE′, DANIEL (1661?–1731). Businessman, secret agent, and journalist—this was Daniel Defoe, author of 'Robinson Crusoe'. He was born in London, probably in 1661. He came of a landed family; but his father was a "younger son," who took up the trade of butcher, then retired on his private means.

The Defoes were Dissenters, or Nonconformists—they did not believe in certain practices of the Church of England. Young Defoe was brought up in the strict yet independent beliefs of the Dissenters.

When he was 14 years old he was sent to a Dissenters' academy. In addition to the traditional Latin and Greek, he studied French, Italian, Spanish, history, and became especially well grounded in geography. He studied for the ministry; but, in 1685, he went into the mercantile business. Engaged in foreign trade, he visited France and lived in Spain for a time. Meanwhile, he was also writing and speculating financially. In 1692 he went bankrupt; then he began the manufacture of tiles. Eventually he paid off all his large indebtedness.

Defoe was far more interested in writing than in business. His lively mind was taken up with the problems of the times. In pamphlets, verse, and periodicals, he called for reforms and advances in such varied fields as religious practices, economics, social welfare, and politics. In his 'Essay on Projects', written in 1698, he made suggestions for a national bank, reformed bankruptcy laws, asylums, and academies of learning. He always stressed the need for tolerance, often using satire for emphasis.

In 1702 he put out a pamphlet titled 'The Shortest Way with Dissenters', satirizing the Tories' persecution of Dissenters. The government arrested him. For three days in 1703 he stood in the pillory while people brought flowers to him. They admired the spirit of this "middle-sized spare man . . . of a brown complexion . . . hooked nose, sharp chin, gray eyes, and a large mole near his mouth." Defoe commemorated his experience in verses called 'Hymn to the Pillory'.

After some months in prison he was released in 1704 through the influence of Robert Hartley, a statesman who became his patron. Defoe then wrote political pamphlets for Hartley, and served as his secret agent in working for the union of Scotland and England.

In 1704 Defoe also started *The Review*, a brilliant periodical discussing the questions of the day. It was the first of many such periodicals with which Defoe was connected—forerunners of the modern newspaper (*see also* English Literature, section "The 18th Century"). As people then did not care for fiction, Defoe also wrote "true histories" of pirates and thieves, spicing facts with imagination. In 1719 he published 'Robinson Crusoe' (*see* Robinson Crusoe).

Defoe's other major works include: A satirical poem, 'The True-born Englishman' (1701); 'Moll Flanders' (1722); 'A Journal of the Plague Year' (1722).

DE FOREST, LEE (born 1873). The broadcasting of sound—or radio broadcasting as we know it today—began when Lee De Forest invented the *audion* tube. His invention revolutionized the living habits of millions, yet he made almost nothing on it.

De Forest's life was brilliant and stormy. He was born in Council Bluffs, Iowa, Aug. 26, 1873. His father was a Congregationalist minister, who, in 1881, became head of Talladega College for Negroes in Alabama. Young Lee was puny and made few friends. To fill his lonely hours, he turned to science. When only 13 he boastfully believed he had discovered "perpetual motion" and admired his own "genius."

A scholarship enabled him to attend the Sheffield Scientific School at Yale University. Some classmates called him the "homeliest and nerviest student in school." He worked relentlessly and earned his doctor of philosophy degree in 1899.

While he earned his living at various jobs, he steadily experimented after hours. One problem especially challenged him. Marconi had already sent the "dot-dash" of the telegraph code through the air by *radio waves;* but no one had found a way to broadcast music or the voice. Experimenting with Fleming's *vacuum* tube, De Forest introduced a third part—a grid between the filament and the plate (*see* Radio). He patented this *audion* tube in 1907 and broadcast the great voice of Enrico Caruso in 1910.

Radio broadcasting was born, but the public paid no heed. Discouraged, De Forest sold the rights to the tube to a telephone company. In the following years, he took out over 300 patents on radio and other electronic devices. One invention was "phonofilm," a forerunner of sound-track motion-picture film. In 1923 he showed the first public "talking" movie.

Wide recognition came to him in his later years. He won the Edison medal in 1946. Many people acclaimed him the "father of radio."

DE KALB, JOHANN (1721–1780). When only 16 years old, ambitious Johann Kalb left his peasant home in Bavaria to seek adventure. Six years later, he turned up in the French army as "Jean de Kalb," with the assumed title of "baron." Young "Baron de Kalb" rose swiftly to the rank of brigadier general.

In 1767 the French government sent him to America to investigate secretly the possibilities of a revolt by the American Colonies against England. They were not yet ready. When they did rebel, he offered his service. With his protégé, the young Marquis de

Lafayette he sailed from France and joined Washington's army in 1777 He was made a major general

In 1780 he was sent south with some 2 000 men to relieve besieged Charleston S C At the battle of Camden S C August 16 he was second in command to Gen Horatio Gates When Gates fled the field De Kalb and his men fought off the British force until De Kalb fell with 11 wounds Three days later he died a British prisoner A monument to him was erected in Camden in 1825 His old companion in arms Marquis de Lafayette laid the cornerstone

DE LA MARE WALTER JOHN (born 1873) The gay puckish verses Walter de la Mare wrote for his own four children became favorites of children everywhere His Songs of Childhood and Peacock Pie sparkle with the fancy and humor of little children's own world of discovery and dreams

He was born April 25 1873 in the village of Charlton in Kent England He was of Huguenot and Scottish descent His father James Edward de la Mare was a church warden his mother Lucy Browning de la Mare the daughter of a naval surgeon

Walter was educated at St Paul's Cathedral School in London When he was 16 years old he founded *The Choristers Journal* the school magazine and wrote most of the first issues Though shy he had an eye for business inserting advertisements to sell his stamps One read— Stamps! Stamps! Stamps! Keep your money till de la Mare gets his *superb* duplicate collection To be sold at ruinous prices

In 1890 he went to work for the Anglo-American Oil Company as a bookkeeper He held the monotonous job for 18 years later saying I think that one can find interest in any task which has *got* to be done Meanwhile he continued to write often working on a story or poem at the noon hour

Writing under the name Walter Ramal he sold his first story Kismet in 1895 At that time he dressed like a poet —long hair flowing tie and broad hat Every night when he went upstairs to say good night to his two sons and two daughters he took them a poem as naturally as other parents took a drink of water

In 1908 his writings earned him a government pension He retired to the country life he so loved and devoted himself exclusively to writing About half his work was prose some of it about the supernatural In 1922 he won the James Tait Black prize for his Memoirs of a Midget —a fictional autobiography of a tiny gentlewoman His children's works include fairy books short stories and The Three Mulla-Mulgars —a story of three royal monkeys searching for their kingdom the Valleys of Tishnar

His adult poems include The Listeners and Winged Chariot —the latter written when he was nearly 80 years old At that time a friend only middle aged said I always come away from a visit with him feeling refreshed and happily stretched in mind

DELAWARE—*The "Blue Hen"* STATE

DELAWARE An automobile can travel the length of beautiful little Delaware in an afternoon but in that short time it will cross many a stretch of historic ground Not only was Delaware one of the 13 original colonies it was also the first state of the Union for in 1787 it was the first to ratify the Federal Constitution In the early days it was a gateway of exploration and settlement and a leader in commerce and industry Much of this colorful past lingers today living side by side with modern industry and agriculture

One of the Middle Atlantic group of states Delaware is wedged in between New Jersey Pennsylvania and Maryland It occupies the northeastern part of the fertile Delmarva Peninsula between Delaware Bay and Chesapeake Bay (*see* Chesapeake Bay)

Among the states of the Union Delaware is the second smallest in area It is only slightly larger than Rhode Island Its greatest length is 110 miles from north to south The greatest width is a scant 35 miles the narrowest only about 10 miles With 318 085 people Delaware is also one of the smallest states in population ranking 46th Yet it is among the most densely populated states Delaware has only three counties—New Castle Kent and Sussex

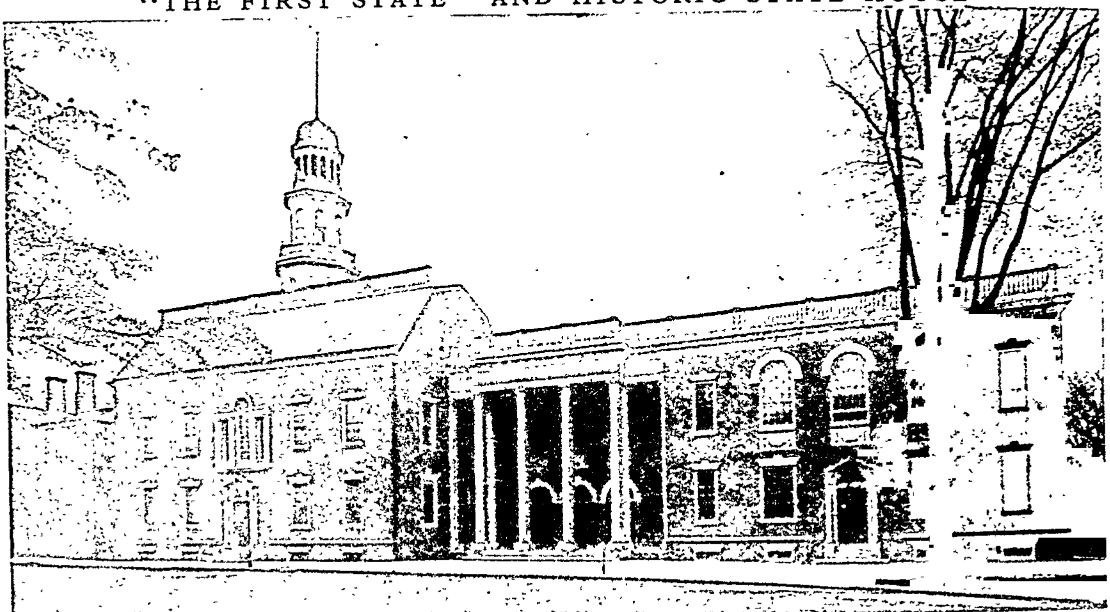
In the northern curved tip of the state is the city of Wilmington Here one third of the people of Delaware live This busy modern city has shipyards foundries mills factories and a marine terminal for ocean vessels (*see* Wilmington) The rest of Delaware is almost entirely agricultural—a gentle land of farms truck gardens and orchards

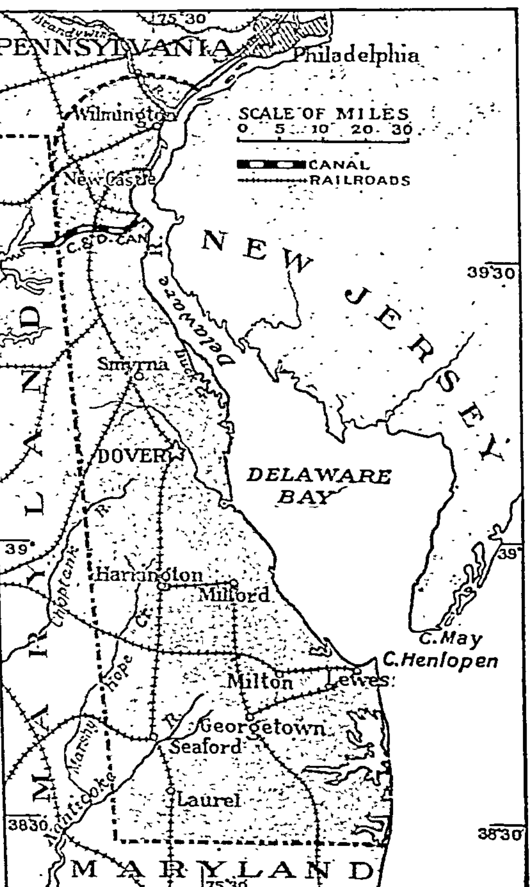
Extending the length of the state the superb Du Pont highway passes through a succession of drowsy market centers They are serene little towns beautiful with aged shade trees village greens and weathered homes built in early American simplicity From the Du Pont highway other excellent roads lead east and west to tidewater farming centers and fishing hamlets Today these towns seem to slumber In the early days of the nation however they were thriving ports crowded with commerce and with shiploads of eager immigrants coming to the New World

Natural Advantages Bring Early Settlement

The first white man to see the shores of Delaware was Henry Hudson On Aug 28 1609 as he sailed the *Half Moon* along the Atlantic coast in search of a passage to the East Indies he turned into Delaware Bay but saw it was a fresh water outlet A year later on August 27 Capt Samuel Argall sighted

"THE FIRST STATE" AND HISTORIC STATE HOUSE





State House at Dover was built in 1789-92 and is still used for state offices. It is on the site of Kent County Court House, erected in 1722, and contains bricks of the earlier building. Legislative Hall, constructed in 1933, is the present capitol. The map shows how Delaware Bay and Delaware River offered shelter to early seafaring settlers.

the bay from his pinnace *Discovery*. He named the southern point of land (now Cape Henlopen) Cape La Warr, in honor of Lord de la Warr, governor of Virginia. From this came the name "Delaware."

The adventurous Dutch captains who explored the bay region from 1614 to 1620 saw a forested land spreading back from rolling dunes on the seacoast and from tidal marshes on the bay. Many inlets in the shore line and a network of navigable rivers and tidal creeks offered shelter for ships and easy water transport for inland settlements. Rich forests promised lumber for houses and fuel for warmth. The wealth of deer, fish, and game birds assured food in plenty. Profitable trade awaited, for Indians came down the Delaware River laden with furs for barter.

As part of the North Atlantic coastal plain, Delaware is virtually level. Small, steep hills and deep ravines break the land in only a small corner of the northwest where it juts into the Pennsylvania foothills of the Piedmont Plateau. There at Centerville, Delaware reaches its highest point—440 feet. Elsewhere it rarely rises more than 60 feet above sea level. Geologically young, the soil ranges from a light alluvial sand to heavy clay. For the most part it is sandy loam. Flat surfaced and almost free from stones, it is easily worked.

When Capt. Cornelis Hendricksen, first explorer of the Delaware River, in 1614, returned to Holland in his ship *Onrust* ("Restless"), he took care to report on the climate. His record in 1616 declared, "He hath found the climate of the said Country to be very

Continued on page 55

DELAWARE (Del.) Named for Delaware Bay. Captain Argall sailing to Virginia was blown from his course into a bay, named it for Lord de la Warr, Virginia's first governor.
Nickname Diamond State because it is small in size but important. Also Blue Hen State for Revolutionary War regiments who adopted game cocks of this breed as mascots and First State for being the first state to ratify the Federal Constitution.
Seal Wheat, corn, ox signifying agriculture engraved on a shield, a soldier and a farmer stand at either side; upon shield's crest is a ship in full sail.
Motto Liberty and Independence
Flag: For description and illustration *see* Flags
Flower Peach blossom **Bird** Blue hen chicken
Tree American holly **Song** Our Delaware—words George B Hynson, music William M S Brown

THE GOVERNMENT

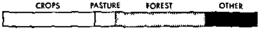
Capital Dover (since 1777)
Representation in Congress Senate 2, House of Representatives 1, Electoral votes 3
General Assembly Senators 17, term 4 years; Representatives 35, term 2 years. Convenes 1st Tues in Jan in odd years. Session limit 60 days
Constitution Adopted 1897. Amendment must be passed by ⅔ majority of elected members at 2 successive legislative sessions. (Need not be ratified by voters.)
Governor Term 4 years. Only two consecutive terms
Other Executive Officers Lieutenant governor, attorney general, treasurer, auditor, all elected, terms 4 years except treasurer and auditor 2 years. Secretary of state appointed by governor with consent of the Senate, term at the pleasure of governor
Judiciary: Supreme court—3 justices. Chancery court—Chancellor and vice chancellor. Superior court—5 justices. All of these judges appointed by governor with consent of the Senate, terms for all 12 years
County 3 counties, each governed by a levy court of 3 members and officers, court members and officers elected, terms 2, 4 and 6 years
Municipal Mayor-council plan most common, some municipalities also have a city manager
Voting Qualifications Age 21, residence in state 1 year, in county 3 months, in district 30 days. Literacy test required

TRANSPORTATION AND COMMUNICATION

Transportation Railroads 300 miles. First railroad Delaware River to Elk River 1831. Rural roads 3,800 miles. Airports 19
Communication Periodicals 5. Newspapers 22. First newspaper *Wilmington Courant* 1762. Radio stations (AM and FM) 7, first station WHAV (later WDEL) Dover, licensed July 30, 1922. Television stations 1, WDEL-TV, Wilmington, began operation June 30, 1949. Telephones 144,000. Post offices 66

THE PEOPLE AND THEIR LAND

Population (1950 census) 318,085 (rank among 48 states—46th), urban 62.6%, rural 37.4%. Density 160.8 persons per square mile (rank—9th state)
Extent Area 2,057 square miles, including 79 square miles of water surface (47th state in size)
Elevation Highest, Centerville 440 feet; lowest, sea level
Temperature (°F.) Average—annual 55°, winter 35°, spring 53°, summer 74°, fall 58°. Lowest recorded −17° (Millsboro Jan. 17, 1893); highest recorded 110° (Millsboro July 21, 1930)
Precipitation Average (inches)—annual 44, winter 10, spring 11, summer 13, fall 10. Varies from about 40 in north central to about 44 inches in extreme north and middle portions
Natural Features Mostly level country, hilly section extends north from Christina River to Piedmont Plateau, tidal marshes stretch along Delaware River and Bay. Atlantic coast line cut by many inlets and bays. Principal rivers: Christina, Delaware, Nanticoke
Land Use Cropland 36%, nonforested pasture 8%, forest 35%, other (roads, parks, game refuges, wasteland, cities, etc.) 21%



Natural Resources *Agricultural*—sandy loam soil, level land, temperate climate, adequate rainfall, long growing seasons. *Industrial*—kaolin (white clay), sand and gravel, granite, forests, fish. *Commercial*—nearness to large metropolitan area provides farm markets, harbors on bays, recreational beach areas

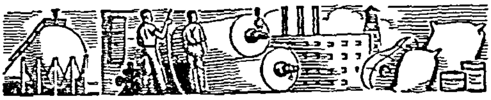
OCCUPATIONS AND PRODUCTS

What the People Do to Earn a Living

Major Industries and Occupations 1950

Fields of Employment	Number Employed	Percentage of Total Employed
Manufacturing	41,076	32.6
Wholesale and retail trade	20,3[illegible]6	16.1
Agriculture, forestry, and fishery	11,438	9.0
Construction	10,494	8.3
Professional services (medical, legal, educational, etc.)	10,170	8.0
Transportation, communication and other public utilities	9,671	7.6
Personal services (hotel, domestic, laundering, etc.)	9,044	7.1
Finance, insurance and real estate	3,984	3.1
Government	3,892	3.1
Business and repair services	2,892	2.2
Amusement, recreation and related services	1,045	0.8
Mining	84	0.1
Workers not accounted for	2,541	2.0
Total employed	126,637	100.0

Delaware Fact Summary



What the People Produce

A. Manufactured Goods (Rank among states—36th)
Value added by manufacture* (1952), $372,445,000

Leading Industries in 1947 (with Principal Products)	Value Added by Manufacture	Rank among States
CHEMICALS AND ALLIED PRODUCTS (Such as plastics materials; synthetic fibers, etc.)	$59,863,000	20
FOOD AND KINDRED PRODUCTS .... Canned fruits, vegetables, soups; poultry dressing, animal feeds	22,591,000	41
LEATHER AND LEATHER PRODUCTS	14,916,000	15
TEXTILE MILL PRODUCTS	12,320,000	29
MACHINERY (EXCEPT ELECTRICAL)	12,250,000	32

*For explanation of value added by manufacture, see Census

B Farm Products (Rank among states—45th)
Total cash income (1952), $103,803,000

Products	Amount Produced (10-Year Average)	Rank within State*	Rank among States†
Chickens.......	180,513,000 lbs.	1	2
Milk...........	79,000,000 qts.	2	46
Corn...........	4,042,000 bu.	3	32
Eggs.	11,000,000 doz.	4	43
Truck crops . .	100,000 tons	5	25

*Rank in dollar value †Rank in units produced

C. Fish (Rank among states—18th)
(Marine waters and coastal rivers, 1950), catch, 160,721,000 lbs ; value, $3,141,000

D. Minerals (Fuels, Metals, and Stone)
Annual value (1951), $644,000
Rank among states—48th

Minerals (1951)	Amount Produced	Value
Sand and gravel.......	655,000 tons	$364,000
Stone	99,000 tons	245,000
Clays	36,000 tons	35,000

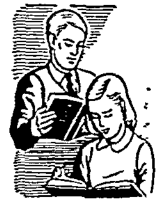
E Trade

Trade (1948)	Sales	Rank among States
Wholesale..........	$483,721,000	41
Retail.............	382,305,000	45
Service............	27,798,000	46

LARGEST CITIES (1950 census)

Wilmington (110,356): seaport on Delaware River; chemical and powder companies; railroad repair shops; produces vulcanized fiber, glazed leathers, and railroad cars.
Newark (6,731): University of Delaware; makes fiber and allied products, paper, hosiery, and canned food.
Dover (6,223): state capital; industrial center of fruit-growing region; poultry canning; latex products.
New Castle (5,396): historical city on Delaware River.
Elsmere (5,314): residential suburb of Wilmington.
Milford (5,179): trading center for lower Delaware.

EDUCATION



Public Schools: Elementary and secondary school districts, 110. Compulsory school age, 7 through 16. State Board of Education composed of six members appointed by the governor for 3-year terms, and the presidents of the University of Delaware and Delaware State College, who serve ex officio. State supt. of public instruction appointed by State Board of Education for 1-year term. Area school board of 7 members appointed by the resident judge. Boards of education for each school district composed of 4 members. In Kent and Sussex counties and part of New Castle, boards are elected by voters of district. The remainder are appointed by resident judge of county. City boards of education appoint city superintendents.
Private and Parochial Schools: 43.
Colleges and Universities (accredited): Colleges—white, 2; Negro, 1. Junior college, 1. State-supported schools include the University of Delaware, Newark; Delaware State College (for Negroes), Dover.
Libraries: City and town public libraries, 18; New Castle county contracts for service with Wilmington Institute Free Library; Library Commission gives aid in developing library service for other 2 counties. Noted special libraries: Memorial Library, Univ. of Delaware; Historical Society of Delaware, Wilmington.
Outstanding Museums: Delaware Art Center, Wilmington; Delaware State Museum, Dover.

CORRECTIONAL AND PENAL INSTITUTIONS

Ferris School for Boys, Marshallton; Woods Haven School for Girls, Claymont; Kruse School (for Negro girls), Marshallton; New Castle County Workhouse, Wilmington; Detention Home, Wilmington.

PLACES OF INTEREST*

Amstel House—built about 1730; museum of New Castle Historical Society; colonial art and handicrafts (6).
Block House—Claymont; built 1654 by John Risingh, governor of New Sweden; probably only building remaining of original Naaman's Creek settlement (2).
Bombay Hook National Wildlife Refuge—important waterfowl sanctuary on Atlantic Flyway (10).
Cooch's Bridge—site of only battle of Revolution fought on Delaware soil; monument to skirmish between Washington's troops and British in 1777 (7).
Drawyers Presbyterian Church—near Odessa; inside are slave gallery and precentor's (choir leader's) box (8).
England Manor House—near Newark; built 1747 (5).
Fort Miles—Lewes; principal Coast Artillery station for Delaware Bay area during World War II (16).
Friends' Centre Meeting House—built 1796 in Centerville; still used by the Quaker congregation (1).
Greenbank Mill—on Red Clay Creek since 1790; one of few water-powered gristmills still running (4).
Henry Francis du Pont Winterthur Museum—Winterthur; American decorative arts of 1640–1830 shown in more than 100 period rooms; southeast of (1).
Holy Trinity (Old Swedes) Church—Wilmington; some parts date back to 1698; graves of settlers (4).
Mary Corbit Warner Museum—Odessa; in David Wilson Mansion, Georgian colonial house built about 1769, many heirlooms exhibited; Corbit Library (8).
Old Court House—New Castle; colonial capitol 1676–1777; New Castle County courthouse until 1881 (6).

*Numbers in parentheses are keyed to map.

Delaware Fact Summary

Old Town Hall—designed 1798 by one of Wilmington's early French settlers, Peter Bauduy much of original craftsmanship remains historical exhibits (4)
Rehoboth Beach—state's "summer capital', popular white sand beach on Atlantic coast, southeast of (16)
Robinson House—faces Naaman's Creek near Claymont once an inn on King's Highway (2)
Rockford Tower—15 stone archways around observation platform frame different views near Wilmington (4)
Rodney Square—civic center of Wilmington statue honors Caesar Rodney, who rode to Philadelphia, 1776, to cast decisive Delaware vote for independence (4)
Rosedale Cheese Plant—west of Dover, Amish Mennonites in traditional dress make 200-pound cheeses (11)
Seaford—oldest nylon plant of E I du Pont de Nemours and Company is located here (18)
State House—Dover, completed in 1792, some materials used in its construction were salvaged from Kent County courthouse, originally on this site (12)
Wilmington—*see* Wilmington and places keyed to (4)
Zwaanendael Museum—Lewes historical building modeled after part of ancient Town Hall, Hoorn, Holland, exhibits early Dutch items (16)

STATE PARKS*

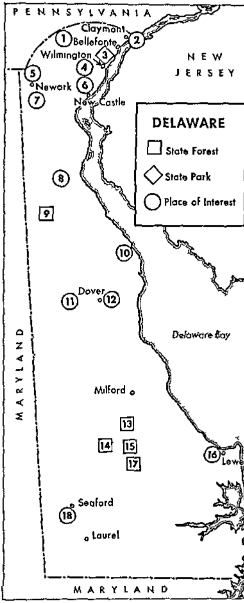
Brandywine Springs—57 acres near Wilmington and (3)
Fort Christina—in Wilmington commemorates landing of Swedish colonists at The Rocks, 1638 (3)
Fort Delaware—200 acres on Pea Patch Island near Delaware City, Civil War prison south of (6)
Indian River Inlet—recreational park south of Rehoboth Beach along the Atlantic Ocean southeast of (16)
Trap Pond—1 000 acres near Laurel, southeast of (18)

STATE FORESTS*

Appenzellar Tract (Sussex County)—45 acres (13)
Blackbird (New Castle County)—676 acres (9)
Ellendale (Sussex County)—993 acres (15)
Owens (Sussex County)—170 acres (14)
Redden (Sussex County)—2 820 acres (17)

THE PEOPLE BUILD THEIR STATE

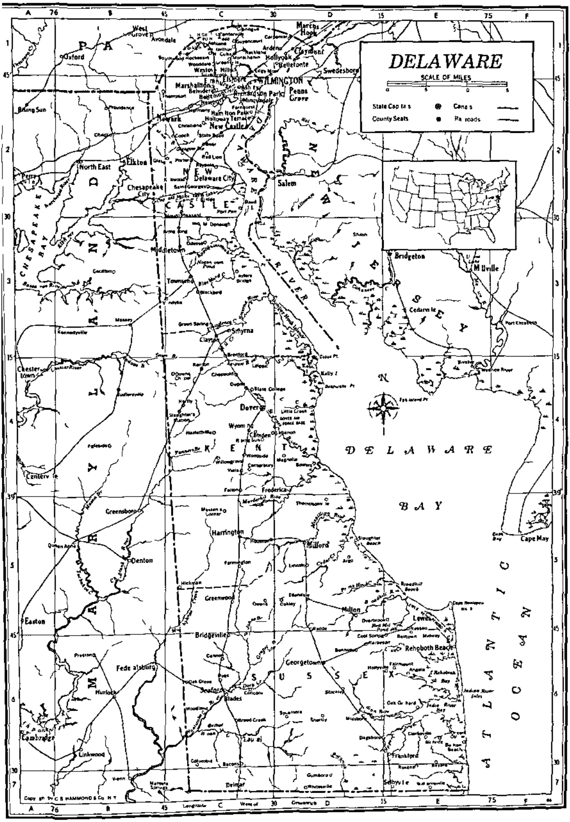
1609—Henry Hudson, in the *Half Moon,* discovers what is now Delaware Bay and River while seeking the Northwest Passage
1610—Samuel Argall sights Delaware Bay, naming it for Lord de la Warr, governor of Virginia
1614—Cornelis Hendricksen explores Delaware River
1621—Dutch West India Company formed to colonize Delaware area
1629—West India Company adopts charter setting up system of patroons (proprietors of tracts of land), Samuel Godyn and patroons buy land between Bombay Hook and Cape Henlopen from Indians, purchase registered at Fort Amsterdam, 1630
1631—Expedition of 28 men from Holland, under Capt Peter Heyes, plants colony near present Lewes, names it Zwaanendael ("valley of swans") Indians massacre colonists within the year
1635—Dutch West India Co buys land from patroons
1638—Swedish colony settles at The Rocks, within limits of present Wilmington, first permanent white settlement in Delaware colonists build Fort Christina named for Swedish queen, name surrounding area New Sweden, Peter Minuit, a Dutchman, is named first governor of colony
1639—First Negro slave in Delaware arrives at Fort Christina
1640—Dutch, Swedish, and Finnish colonists settle in New Sweden Reorus Torkillus, first Lutheran minister in North America, arrives at Fort Christina.
1643—Johan Printz becomes governor of New Sweden, he builds new forts in what is now New Jersey and Pennsylvania
1651—Peter Stuyvesant, governor of Dutch New Amsterdam (now New York), builds Fort Casimir on site of New Castle



*Numbers in parentheses are keyed to map

Delaware Fact Summary

1654—Swedish settlers capture Fort Casimir from Dutch, May 21; rename it Fort Trinity.
1655—Stuyvesant recaptures Fort Trinity and renames it Casimir; takes Fort Christina; all Swedish claims surrendered to Dutch.
1656—Dutch West India Company sells Fort Casimir and surrounding area to City of Amsterdam; settlement renamed New Amstel; Amsterdam acquires whole Delaware River valley, 1663.
1657—First school in area opened by Dutch at New Amstel.
1664—England conquers Dutch American colonies; Delaware becomes part of "Duke of York's Province" by grant of Charles II of England; New Amstel renamed New Castle.
1671—New Castle is made a bailiwick (special province) with central authority over Delaware River area.
1672—Dutch and English at war: Dutch capture New York and recover former colonies, including Delaware, 1673, English regain control by Treaty of Westminster, 1674.
1682—Duke of York grants Three Lower Counties (present state of Delaware) to William Penn: Penn lands in ship the *Welcome* at New Castle, October 27; counties become part of Province of Pennsylvania by Act of Union passed by General Assembly; counties accept Penn's "Frame of Government," which provides government based on personal, political, and religious freedom.
1683—Penn changes names of Deal County to Sussex and St. Jones County to Kent.
1684—Lord Baltimore protests to king against grant of Delaware to Penn, claiming encroachment on Maryland grant; dispute lasts some 85 years.
1698—Holy Trinity (Old Swedes) Church founded at what is now Wilmington.
1701—Penn grants "Charter of Privileges," giving greater powers to local governments.
1704—Lower Counties secede from Provincial Assembly of Pennsylvania; they form their own assembly which meets at New Castle in November, but continue under rule of governor of Pennsylvania.
1739—Wilmington chartered as a borough, November 16.
1761—James Adams sets up first printing press in colony at Wilmington; publishes *Wilmington Courant* in 1762, first newspaper in colony.
1763—Charles Mason and Jeremiah Dixon survey Delaware's southern and western boundaries; adjusted borders approved by George III of Great Britain, 1769.
1774—Caesar Rodney, born at Dover, Thomas McKean, and George Read appointed Delaware delegates to first Continental Congress, August 22.
1776—Caesar Rodney rides on the night of July 1–2 from Dover to Continental Congress at Philadelphia to cast Delaware's vote for independence. Constitution of "Delaware State" is framed at New Castle, September 21; contains antislavery clause; Dr. John McKinley is first president of state; New Castle is first capital. First Delaware regiment, "Blue Hen's Chickens," organized under Col. John Haslet: it establishes famous war record. One of first naval battles of Revolution fought off mouth of Christina Creek, May 8–9.
1777—Capital moved from New Castle to Dover, May 12. Battle of Cooch's Bridge near Newark is only battle of Revolution fought in Delaware, September 3; British occupy Wilmington, September 13.
1779—Assembly ratifies Articles of Confederation, February 1.
1781—Delaware's Thomas McKean elected president of Continental Congress, July 10.
1785—Oliver Evans, born at Newport, places in operation machinery that revolutionizes flour milling.
1786—Delaware is one of five states to send delegates to Annapolis Convention.
1787—Delaware is first state to ratify U. S. Constitution, December 7. Assembly passes law prohibiting importation of slaves into state.
1790—John Fitch's steamboat put into regular service on Delaware River, August 5.
1791—Public library opened at Dagsborough.
1792—New state constitution adopted; Joshua Clayton, last president of state, is first governor.
1793—Louis Philippe, Duke of Orléans, banished from France, becomes schoolteacher in Wilmington; later becomes French king, 1830–48.
1795—Bank of Delaware chartered at Wilmington, February 9; is first bank in state.
1802—E. I. du Pont begins manufacture of gunpowder in mill near Wilmington.
1812—*Wasp*, commanded by Capt. Jacob Jones, born near Smyrna, captures British ship *Frolic* in War of 1812; British blockade Delaware River.
1813—British fleet bombards Lewes.
1814—Capt. Thomas Macdonough, born at McDonough, defeats British at battle of Lake Champlain.
1829—State free school law enacted. Chesapeake and Delaware Canal, begun in 1801, is opened.
1832—Wilmington chartered as a city, January 18.
1833—Newark College chartered; opens at Newark, May 8, 1834; becomes Delaware College, 1843, and University of Delaware, 1921.
1844—First iron, propeller-driven, seagoing ship built in U. S., the *Bangor*, launched at Wilmington.
1849—First state agricultural society formed.
1861—Delaware refuses to secede from Union despite much pro-Southern sympathy; Delaware men fight on both sides during Civil War.
1862—State rejects plan for gradual freeing of slaves.
1897—Present state constitution adopted, June 4.
1905—Delaware abolishes pillory as means of punishment but retains the whipping post.
1911—Construction of state-long Du Pont Boulevard started; completed, 1924.
1916—Delaware National Guardsmen sent to Deming, N. M., in expedition against Mexican bandits.
1917—State Highway Department created.
1919—State begins educational modernization program.
1921—Assembly ratifies boundary survey of 1892 settling boundary dispute with Pennsylvania, March 21.
1937—U. S. Biological Survey buys land near Smyrna for Bombay Hook National Wildlife Refuge.
1938—Du Pont de Nemours perfects nylon, revolutionary synthetic fabric.
1941—Sunday "Blue laws" repealed.
1950—University of Delaware admits Negro students for the first time.
1951—Delaware Memorial Bridge across Delaware River to New Jersey opens. Legislature creates independent state Supreme Court.
1952—U. S. Chamber of Commerce reports that Delaware had the highest average state expenditure per pupil for education in 1950 ($327.05).
1954—U. S. Supreme Court bans segregation in public schools in 5 cases, one involving Delaware.


DELAWARE
SCALE OF MILES
State Capitals
County Seats
Canals
Railroads
WILMINGTON
Dover
New Castle
Newark
Middletown
Smyrna
Milford
Georgetown
Lewes
Rehoboth Beach
Seaford
Laurel
Delmar
Harrington
Bridgeville
Frederica
Milton
Delaware City
Claymont
Elsmere
Townsend
Clayton
Camden
Greenwood
Selbyville
Frankford
N E W
C A S T L E
K E N T
S U S S E X
D E L A W A R E
B A Y
A T L A N T I C
O C E A N
N E W
J E R S E Y
Salem
Penns Grove
Swedesboro
Bridgeton
Millville
Cape May
Elkton
North East
Chesapeake City
Chestertown
Centreville
Greensboro
Denton
Easton
Cambridge
Federalsburg
Hurlock
Preston
Linkwood
Marcus Hook
West Grove
Avondale
Oxford
Rising Sun
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Longitude
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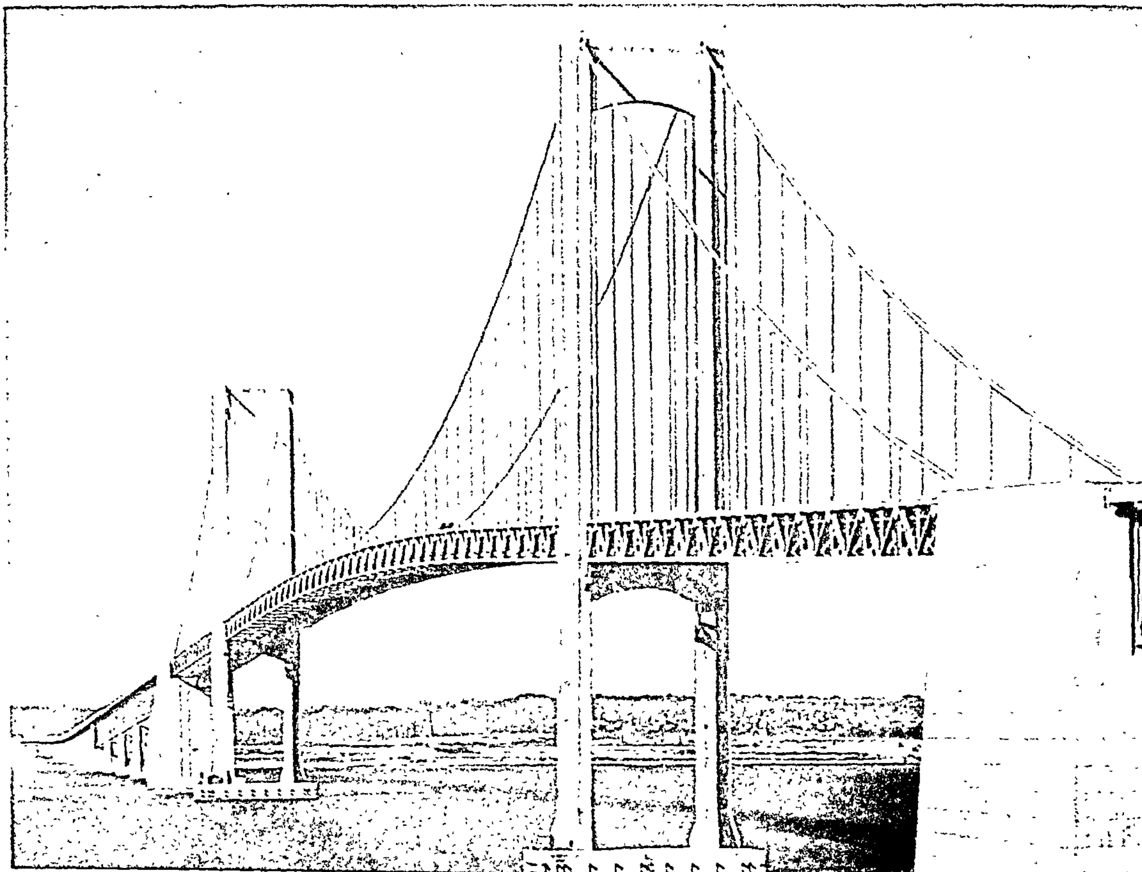


The Delaware Memorial Bridge towers over the Delaware River to connect Delaware and New Jersey at about three miles south of Wilmington. With an overall length of two miles and a center span of 2,150 feet, it is one of the great bridges of the world.

DELAWARE

COUNTIES

Kent	37,870	C 4
New Castle	218,879	C 2
Sussex	61,336	D 6

CITIES AND TOWNS

Angola	22	E 6
Arden	842	C 1
Argo	75	D 5
Armstrong		C 3
Ashland	65	C 1
Ashley	860	C 2
Bacons	28	C 6
Bayard		E 7
Bear	150	C 2
Bellefonte	1,472	D 1
Bellemoor	1,200	C 2
Belltown	250	E 6
Belvidere	850	C 2
Bennum		D 6
Bethany Beach	190	E 6
Bethel	271	C 6
Blackbird	50	C 3
Blades	789	C 6
Bowers	284	D 4
Brenford	30	C 3
Bridgeville	1,468	C 6
Broad Creek		C 6
Camden	606	C 4
Cannon	150	C 6
Canterbury	50	C 4
Carpenter		D 1
Centerville	225	C 1
Cheswold	292	C 4
Christiana	500	C 2
Clarksville	150	E 6
Claymont	5,370	D 1
Clayton	825	C 3
Columbia	35	C 6
Concord	100	C 6
Cooch	12	C 2
Cool Spring	25	D 6
Dagsboro	474	D 6
Delaware City	1,363	C 2
Delmar	1,015	C 7
DOVER	6,223	C 4
Downs Chapel	30	C 4
Dupont	10	C 4
Edge Moor	25	C 1
Ellendale	321	D 5
Elmhurst	2,100	C 2
Elsmere	5,314	C 2
Fairmount	48	E 6
Farmington	113	C 5
Farnhurst	150	C 2
Felton	455	C 4
Frankford	615	E 6
Frederica	675	D 4
Georgetown	1,923	D 6
Glasgow		C 2
Glasgow Sta.		B 2
Granogue	80	C 1
Green Spring	10	C 3
Greenville	230	C 1
Greenwood	746	C 5
Gumboro	50	D 7
Guyencourt		C 1
Hamilton Pk.	800	C 2
Harbeson	142	D 6
Harmony	10	C 2
Harrington	2,241	C 5
Hartly	139	C 4
Hazlettville	20	C 4
Hickman	200	C 5
Hockessin	1,200	C 1
Holloway Terrace	1,000	C 2
Hollyoak	1,450	D 1
Hollyville	20	D 6
Houston	332	C 5
Kenton	211	C 4
Kirkwood		C 2
Laurel	2,700	C 6
Lebanon	150	D 4
Leipsic	253	C 4
Lewes	2,904	E 5
Lincoln	400	D 5
Little Creek	266	D 4
Magnolia	207	D 4
Marshallton	1,600	C 2
Masten's Corner	30	C 5
McDonough		C 3
Middletown	1,755	C 3
Midway	45	E 6
Milford	5,179	D 5
Millsboro	470	D 6
Millville	270	E 6
Milton	1,321	D 5
Minquadale	1,500	C 2
Montchanin	500	C 1
Mt. Cuba	300	C 1
Mt. Pleasant	87	C 2
Nassau	120	E 5
New Castle	5,396	C 2
Newark	6,731	C 2
Newport	1,171	C 2
Oak Grove	50	C 6
Oak Orchards		E 6
Oakley		D 5
Ocean View	450	E 6
Odessa	467	C 3
Overbrook	50	D 5
Owens	30	C 5
Port Penn		C 2
Porter	50	C 2
Red Lion	50	C 2
Redden		D 5
Rehoboth Beach	1,794	E 6
Reybold		C 2
Richardson Park	2,200	C 2
Rising Sun	150	C 4
Rockland	350	C 1
Ross	10	C 6
Roxana	100	E 7
Saint Georges	340	C 2
Seaford	3,087	C 6
Selbyville	1,086	E 7
Shortly		D 6
Silverbrook		C 1
Slaughter Beach	85	D 5
Slaughter's Station	15	C 4
Smyrna	2,346	C 3
Southwood	50	C 1
State College	450	C 4
State Road		C 2
Stockley	70	D 6
Summit Bridge		C 2
Sycamore		D 6
Taylors Bridge	25	C 3
Thompson	4	C 2
Thompsonville	25	D 5
Townsend	441	C 3
Vandyke	5	C 3
Viola	134	C 4
Westover Hills	900	C 1
Whitesville	30	D 7
Williamsville		E 7
Willowgrove	65	C 4
Wilmington	110,356	D 2
Winterthur	200	C 1
Wooddale	32	C 1
Woodland	50	C 6
Woodside	157	C 4
Wyoming	911	C 4
Yorklyn	500	C 1

temperate." No rigorous New England winters awaited Dutch colonists about to be sent to Delaware.

Its position between two arms of the ocean gives Delaware a tempered climate gentler than that of its northern neighbors, yet brisker than in adjacent Maryland and Virginia. Its long growing season, from the latter part of April to mid October, especially favors fruit production. In the north the average annual temperature is about 53° F.; in the south it is three to four degrees higher. During July and August high humidity typical of the Middle Atlantic coast makes the heat "sticky." In the long spring and autumn, however, Delaware is delightfully mild.

The average annual rainfall is about 44 inches, more than enough for the needs of the farmer and the fruit grower. Excess moisture cannot run off rapidly from the flat surface of the land, and in many places swamps have formed. The largest is Pocomoke Swamp, stretching into Maryland. The swamps and tidal marshes and the many ponds, lakes, and slow moving streams are breeding grounds for mosquitoes. For many years these pests interfered with the development of vacation resorts. Drainage canals and other mosquito-abatement measures have brought the pests well under control.

Rich Variety of Plants and Animals

About one third of the state is still in timber, much of it in farm wood lots—chiefly pine, oak, hickory, walnut, beech, maple, ash, sycamore, tulip (yellow poplar), and sweet gum. Other trees and shrubs, chiefly in the south, include loblolly pine, persimmon, magnolia, laurel, wild cherry, holly, and dogwood. Bald cypress and white cedar grow in the swamps, and along the sandy ocean shore grow pitch pine, willow, blackjack oak, red cedar, beach plum, and wax myrtle.

Timber was the source of some of Delaware's earliest industries. Great stands of white oak helped Delaware to become a leader in shipbuilding. Merchant vessels called "Delaware racers" were built by Dutch and Swedish colonists and were famed up and down the seaboard for their speed. Many cargoes of white oak timber were exported to England, Holland, and Sweden. The bark of the black oak supplied tannin for the tanning and dyeing industry, which was widespread in Delaware even before the 18th century. Other woods furnished boxes, baskets, and barrels for the tons of flour and corn meal that were exported when Wilmington was a milling center of the colonies.

After generations of ruthless logging, timber is now protected by state conservation. The state forestry department, established in 1927, has jurisdiction over all woodland. It reforests private land at cost. To encourage planting windbreaks and shelterbelts, reforested lands are supervised by the department and are exempt from taxes for 30 years. The chief public forest is Redden State Forest in Sussex County.

Wildlife and Fishing Industry

Delaware is still a haven for wildlife. The bear, panther, wild cat, and wolf of early days are gone, but muskrat, opossum, red and gray fox, rabbit, squirrel, raccoon, and mink remain. Muskrat trapping in southern marshes is the livelihood of a number of people. Some deer are still found. Diamond back terrapin are now scarce, but were once so numerous and cheap that a law was passed to forbid employers to serve it to their workmen more than three times a week.

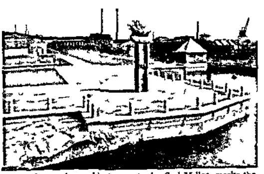
The state lies on the eastern flyway of the annual migration of birds (*see* Migration of Animals). Because of its moderate climate, some of them nest here beyond their usual northern limits. In addition to birds found generally on the Middle Atlantic coast, Delaware has bald eagles, snowy egrets, blue heron, yellow throated warbler, and summer tanager. Ducks, quail, and pheasant are hunted. The copperhead is the only poisonous snake.

Wildlife is kept well stocked by the state board of game and fish commissioners, created in 1911. The board releases game birds and animals in the state and keeps streams and lakes stocked with fish. Some farmland unfit for crops is set aside for game preserves. Delaware also has three national wildlife refuges. The largest is Bombay Hook, a haven of about 14,000 acres for migratory waterfowl on Delaware Bay east of Leipsic. The Cape Henlopen refuge is east of Lewes. The state shares the Killcohook refuge with New Jersey north of Delaware City.

Few states offer more opportunity for fishing in both fresh and salt water. The lakes are fished for crappies and small and large-mouth bass. Power boats sail the bay and coastal waters for flounder, channel bass, kingfish, croaker, and sea trout or weakfish. Surf fishing along the Atlantic coast is popular. Commercial fishermen net a large annual catch, chiefly menhaden, striped bass, sea trout, and shad. Oysters and crabs are also taken and clams are dug. Lewes is the most important fishing port.

In 1936 Delaware joined with Pennsylvania, New York, and New Jersey to form the Interstate Commission on the Delaware Basin. This aimed to conserve

"THE ROCKS" IN WILMINGTON



A wave borne ship in black granite by Carl Milles marks the rock where the first Swedes landed in 1638. Prince Bertil of Sweden presented it to President F. D. Roosevelt in 1938.

and develop the resources of the Delaware River. Sewage and industrial wastes were major problems, for pollution of the waters had virtually wiped out sturgeon and had taken huge toll of the Delaware shad.

Abundant Waterways Gave Early Advantage

No single factor contributed more to the early development of Delaware than its abundant waterways. Its Atlantic coast line is cut by many inlets and bays, chiefly Rehoboth, Indian River, and Assawoman bays. In the days of the small sailing ships these inlets were gateways of commerce. So were the streams leading into the interior.

The watershed of the state is a small ridge on the west boundary, which turns southeast below the center of the state. Flowing east into the Delaware River and Delaware Bay are the Appoquinimink, Smyrna (formerly Duck Creek), Mispillion, and the oddly named St. Jones. On the west slope is Nanticoke River, a tributary of Chesapeake Bay. In the north, the Christina and historic Brandywine rivers, flowing down from Pennsylvania, join to form Wilmington's deep water harbor.

As long as water transport ruled, Delaware was the crossroads of the seaboard. Coastal settlements and those at the head of river navigation built ships and became leaders in coastwise and foreign trade. Tidewater plantations shipped from their own landings. As early as 1654 the Swedish governor, Johan Classon Rising, recognized Delaware's key position and proposed a canal across the neck of the peninsula. In 1797 plans were begun that resulted in opening the Chesapeake and Delaware Canal, 14 miles long, in 1829, one of the earliest in the nation.

Industries and the People Who Built Them

The fall of the rivers is slight, but it was enough to help make Delaware a leader in early industry. Rivers turned mills for grist, lumber, paper, textiles, and explosives. Wagon trains from Pennsylvania and Maryland brought grain to mills on the Christina and Brandywine. The Wilmington market set the price of wheat for the American Colonies. The Delaware millers' invention of kiln-dried corn gave them a hold on the West Indies trade with their cargoes of meal which were free from mold. On the Brandywine the Du Pont mill made its first powder run in 1802, the start of one of the largest industries in the nation. Iron ore in the north and bog iron in Sussex supplied many forges and foundries until late in the 18th century. Even before the Revolution, Wilmington was famed for wagon building. When railroads came, it turned to car building as early as 1836. The first propeller-driven iron ocean ship in America was launched here in 1844.

The abilities of the people who settled Delaware equaled its abundant resources. First came the Dutch, skilled in seafaring, thrifty farmers, and wise in the ways of trade. Then came Swedes, Finns, English, Scots, Irish, Welsh, and French Huguenots. All were earnest, energetic, with a strong sense of business and a stubborn love of independence. Their rugged character left a mark on Delaware history. They kept it a separate colony, with its own rights, despite stormy rule by three different nations. Cherishing liberty, they discouraged slavery even before 1700, and they were leaders in providing jury trials for Negroes as well as whites.

With the decline of sailing ships and the spread of railroads, soon after the Civil War, commerce waned. But the people of Delaware sturdily pursued their own way in a changed world. Industrial Wilmington became a large modern city, but its people still find time for friendly courtesy and warmth. They are proud of their "peaceful little state." Many return to family towns and villages for summer reunions. Lower Delaware turned almost exclusively to farming. There, until recent years, roads were poor, and the isolated villages and farms kept their old customs. Yet in essential matters like education Delaware has shown a soundly progressive spirit.

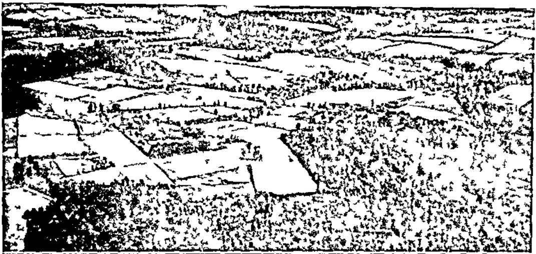
Agriculture a Chief Industry

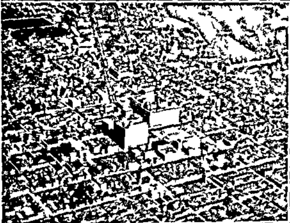
Rural Delaware lies near the greatest metropolitan area in the country. About one fourth of the nation's people live within 250 miles. This gives Delaware farmers ready markets with low shipping costs. They send their produce to Washington, D.C., Baltimore, Philadelphia, New York City, and scores of smaller cities.

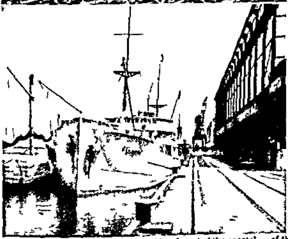
About 70 per cent of the land is in farms. The average holding is almost 115 acres, and about 70 per cent of the farms are worked by the owners. Both soil and markets encourage diversified crops, which tend to prevent widespread distress in times of depression. Corn, grown chiefly in the silt loam of New Castle County, is the leading field crop in value. Also important are truck crops, hay, wheat, soybeans, and potatoes. Sandier loams of Kent and Sussex counties favor vegetables and fruits. In April the country is so lovely with massed pink and white blossoms of apple and peach trees that motorists tour the region on special state-marked trails.

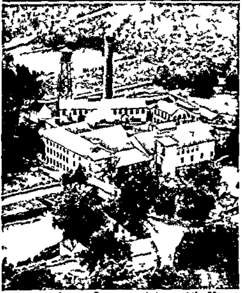
Nearly every small town has a canning or fruit-packing plant. These are busy from late April through autumn. First come asparagus and early peas; then in May and June, strawberries; then starting about July 1, apples and tomatoes; and in August, cucumbers and cantaloupe. With New Jersey and California, Delaware usually leads in the production of lima beans. Sweet potatoes, another major product, thrive in the sandier soils. Those offered at Christmas or Easter are likely to be from Delaware, for the farmers "kiln dry" most of the crop for sale on the off-season markets. Dairying and poultry raising are also important. Sussex is one of the nation's chief counties in production of broilers.

The farmers foster demands for their products by taking steps to keep quality high. Apple growers obtained a state law requiring closed packages of apples to be marked with the owner's name, address, variety, and grade of fruit. Cantaloupe growers sponsored the law that forbids shipment of immature cantaloupes from the state. Agricultural societies have existed since 1804, when New Castle farmers banded









Delaware for the most part is low and *level part of the coastal* plain as can be seen in the Fairchild aerial view at the top In the extreme north is hilly country Neat farms in cropland pasture and woodland occupy about *70 per cent of the total* area In another of these air views (center left) we look out over Wilmington center of commerce and home of one third of the state's population. Ocean vessels tie up at the Marine Terminal (bottom left) in Wilmington's harbor on the Christina River tributary of the Delaware The University of Delaware at Newark (center right) was opened in 1834 Delaware is one of the world's centers for chemical research and manufacturing This paper mill (lower right) is in Wilmington.

together. The first state society was formed in 1849. These groups were largely responsible for teaching farmers to rotate crops and fertilize fields, thus restoring Delaware's celebrated fertility of soil. Today the state board of agriculture works closely with farm problems. The Division of Agricultural Extension of the University of Delaware and its county agents serve thousands of farmers. Its work also includes 4-H Clubs and home demonstration units. The Future Farmers of America and the National Grange are also widely active.

Manufacturing Is Varied But Minerals Are Few

More than half of the manufacturing of Delaware is concentrated in New Castle County, in and around the city of Wilmington (*see* Wilmington). Explosives are no longer made here, but the production of other chemical products has become Delaware's largest industry. Wilmington is known as "the chemical capital of the world." The big chemical companies have plants and large experimental laboratories here and elsewhere in the state. The list of products which they develop or manufacture is almost endless. It includes plastics materials, such as cellophane; synthetic fibers, such as rayon and nylon; drugs and medicines; paints and fertilizers; industrial inorganic chemicals; and compressed and liquefied gases.

Other large industries are the canning of fruits and vegetables and the manufacture of glazed kid and morocco leathers. Delaware has few minerals. Clay products, sand and gravel, and stone are the only ones of value. Nearby coal fields of West Virginia and Pennsylvania give Delaware a low-cost fuel supply.

Highways, the Backbone of Transportation

The state's excellent highway system has grown out of the famous Du Pont Boulevard, completed in 1924. This concrete road was given to the state by Coleman du Pont, great-grandson of the founder of E. I. du Pont de Nemours and Company. The state highway department took control of all public roads in 1935, and Delaware became a leader in building concrete roads, dual highways, and express routes for trucks. In 1951 the Delaware Memorial Bridge across the Delaware River near Wilmington was opened. This two-mile suspension bridge cost $43,900,000 and links the Du Pont Highway and the New Jersey Turnpike.

Because of the many small shipments destined for nearby points, truck routes are more important to Delaware than railroads. The state has about 300 miles of rail lines. One of the first regular steam railway passenger services in the nation, however, began in Delaware on Sept. 10, 1832, on the New Castle and Frenchtown railroad, built a year earlier.

The Chesapeake and Delaware Canal, opened in 1829, has become an important link in the Atlantic Intracoastal Waterway. Connecting Chesapeake Bay and Delaware Bay, it runs about 15 miles south of Wilmington. It is a sea-level channel, 250 feet wide and 27 feet deep.

Towns and Villages Recall History

Delaware is especially attractive to motorists, for nearly every town and village has its historic background. Even the busy city of Wilmington is rich in early American memories. Newark, near by, was one of the earliest junctions of cross-peninsula travel, growing up at the intersection of "two very Publick Roads." Here Mason and Dixon made their headquarters while surveying their famed boundary line. It is the seat of the beautiful University of Delaware. New Castle, oldest town in the Delaware River valley, was a leading port for settlers entering Pennsylvania, Maryland, and Virginia. Here William Penn landed in 1682 to become proprietor of Delaware. In 1776 it became the first capital of the state of Delaware. Its green was laid out by Peter Stuyvesant. The homes of several leaders in colonial and Revolutionary times still stand and are open to the public.

Dover, seat of Kent County and state capital since May 12, 1777, is near the center of the state, an hour's drive from Wilmington. Its wide shaded streets and gracious homes reflect the generous, dignified planning of the colonial period. In 1683 William Penn ordered Dover to be built as a county seat. Kent County courthouse was built before 1697, the rest of the town laid out in 1717. In 1778 a visiting French nobleman wrote, "All the houses in Dover offered a simple but elegant appearance." (*See also* Dover.)

Lewes was the site of the first settlement in Delaware in 1631. In its early years it was a bustling port. Today it houses many Delaware river pilots, and retains its proud tradition as "the saltiest town in Delaware." Behind its Delaware breakwater, begun in 1818, and its outer Harbor of Refuge, ships still take shelter from Atlantic storms. It is a center of salt-water fishing. Five miles south of Cape Henlopen is Rehoboth, "summer capital" and largest seaside resort. Surrounded by the holly trees and the loblolly pines of Sussex County, it is a favorite resort of Washington residents. The chief ports and shipbuilding towns of early days included Milford on the Mispillion, Seaford on the Nanticoke, and Odessa on the Appoquinimink.

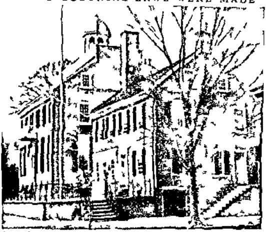
Cultural Heritage and Education

Delaware's first notable literary figure was John Dickinson (1732-1808), "the penman of the Revolution." His family moved there from Maryland in 1734. His political writings helped to persuade the colonies to adopt the Constitution. John Lofland (1798–1849) was an eccentric physician-writer whose prose and poetry on Delaware themes won him local distinction as the "Milford bard." Howard Pyle (1853–1911), famed writer and illustrator, worked chiefly in Wilmington, his birthplace, and his studio is preserved. Other distinguished writers include Christopher L. Ward (1868–1943), Henry Seidel Canby (born 1878), and Anne Parrish (born 1888).

Delawareans prominent in other fields include John Bassett Moore (1860–1947), jurist and historian; Annie Jump Cannon (1863–1941), eminent astronomer; Oliver Evans (1755–1819), inventor; and Thomas Garrett (1789–1871), abolitionist.

Education has advanced swiftly after years of setbacks. As the first Swedish colonists prepared to sail

WHERE COLONIAL LAWS WERE MADE



Assemblies met in the Old Court House in New Castle perhaps as early as 1704 Its cupola is the center of the 12-mile circle that shaped the arc of the state s north boundary

in 1637 the king urged that they be provided with an adequate number of ministers and schoolmasters The first teacher Evert Pietersen did not arrive until 1657 when the Dutch had control As the colony grew the prosperous sent their children to Philadelphia New England or abroad to school In 1796 the legislature established a public school fund but no use was made of it until 1817 Progress was negligible until 1829 when districts were empowered *to establish free schools*

Free education lagged however and in 1918 Delaware by prevailing educational standards ranked below the average for the nation In 1919 the state aided by contributions from private individuals *notably Alfred I du Pont* and Pierre S du Pont began a program of modernization that lifted it to rank among the leading states in the nation in value of school property for each pupil

The University of Delaware at Newark received its charter in 1833 as Newark College In 1843 it became Delaware College and in 1921 the University of Delaware Delaware State College (for Negroes) and Wesley Junior College are *located at Dover*

How Delaware Is Governed

Delaware s constitution adopted in 1897 is its fourth The others were adopted respectively in 1776 1792 *and 1831 Amendments* to the constitution need no ratification by the voters The General Assembly meets on the first Tuesday in January in odd years It is made up of 17 senators *who are elected* for four years and 35 representatives who serve for two years The governor elected *for four years may* not serve a third term Other executives also serve four years except the treasurer and auditor who are elected for two years

Counties are still divided into hundreds a political unit used centuries ago by *the Anglo-Saxons* The pillory was not abolished until 1905 and the whipping post is still used to punish certain crimes Blue laws prohibiting unnecessary work on Sunday though long disregarded were not repealed until 1941

The state is the official home of many of the largest corporations in the United States Industries carrying on their work elsewhere are chartered here to take advantage of its liberal laws of incorporation

First Dutch Settlers Vanquished by Indians

The chronology of Delaware begins with the establishment *of a whaling colony In 1629* patrons of the Dutch West India Company bought land from the Indians stretching from Bombay Hook to Cape Henlopen In the spring of 1631 the *Walvis* (whale) brought 28 men whaling equipment and cattle from Hoorn in Holland to a site near present Lewes They called the settlement Zwaanendael (valley of swans) A quarrel with the Indians ended in the massacre of all the settlers some time before 1632

For the next few years the region remained in the hands of its Indian masters Of Algonquian stock they called themselves the Lenni Lenape (the original people) It was their tradition that they had come long ago from the west to be the first settlers in this region Explorers had praise for the Lenni Lenape and other Indian tribes respectfully called them Grandfather They had formed a defensive confederacy with certain neighboring tribes They were a tall proud people friendly intelligent and brave They resented being called Delawares by the white men until they were told this was the name of a brave warrior It was the Delawares who in 1682 and 1683 made treaties of friendship with William Penn and assigned him rights to the site of Philadelphia (*see* Penn) The trickery of the Iroquois and of the white men weakened the Delawares Unable to defeat them in battle the Iroquois persuaded the Delawares to become arbitrators in the Indian wars At first they refused because intercession was customarily the task of the women The Delawares wanted no such pleading role The Iroquois shrewdly convinced them that this part could be handled only by a tribe with the most honored tradition of strength and courage The Delawares made a pledge to refrain from warfare and to act as peacemakers for the general good

Delaware Indians Driven Out

When the Iroquois had thus made the Delawares into women they dominated them about 1720 with the aid of firearms supplied by northern colonial traders The second great blow at the Delawares came when Governor Thomas Penn defrauded them of land in Pennsylvania in the Walking Purchase of 1737

The Indians had originally sold to William Penn land extending as far as a man can walk in three days Penn in 1683 had walked off the first half of this—about 40 miles—at a normal pace When the time came to measure the remainder Thomas Penn *hired an expert* who managed to cover 86 miles in the additional day and a half When the Delawares protested they were driven out by the Iroquois at the governor s request Destitute and broken in spirit they began their straggling drift westward to the

Wyoming Valley in the Alleghenies, and then on to Kansas, Oklahoma, and Canada.

Swedes Make a Permanent Settlement

Meanwhile a new era had begun for the Delaware colony. The first Swedish people to come to America landed at "The Rocks," on the site of modern Wilmington, in March 1638. Led by Peter Minuit, who had originally been in the service of the Dutch and had built Fort Amsterdam at the mouth of the Hudson River, they built here Fort Christina, named in honor of the Swedish queen. They called the surrounding country New Sweden. More Swedes came in 1640, and with them some Finns. These Scandinavian woodsmen were the first builders of the log cabins that were to be the frontier homes of American pioneers.

Struggles for Control of Colony

New Sweden's trade attracted ambitious Peter Stuyvesant, governor of New Amsterdam. In 1651 his Dutch warships defied the ill-armed Swedish forts, and he built Fort Casimir on the site of modern New Castle. In 1655 Stuyvesant broke the last traces of New Sweden's power, and for the second time Holland controlled Delaware. In 1664 England conquered the Dutch colonies, and Delaware became part of the "Duke of York's Province," by a grant of Charles II.

The Dutch recaptured their lands in 1673. Their rule was ended the next year by the Treaty of Westminster but not until they had established courts at Upland, New Castle, and Lewes. This laid the foundation for Delaware's later claim to be recognized as a separate colony.

Passing from one master to another failed to shake the people from their rugged, independent ways. William Penn landed in New Castle, Oct. 27, 1682, intending to include the "Three Lower Counties" in his patent for Pennsylvania. The Delawareans sent their own delegates to Penn's first assembly, Dec. 6, 1682, and by 1701 had won a new charter entitling them to a separate assembly, which first met in New Castle in November 1704. Thenceforth Delaware, though administered by governors appointed by Penn, sent none of its laws to England for approval by the crown.

Delaware Fights in the Nation's Wars

Although there were many loyalists in the colony, Delaware was in the forefront of the fight for independence. The leaders were Caesar Rodney, Thomas McKean, and George Read, delegates to the Continental Congress. On the night of July 1, 1776, Rodney rode furiously from Dover to Philadelphia to vote with McKean, thus giving Delaware's support to the resolution calling for separation of the colonies from England. On Sept. 21, 1776, the three counties convened at New Castle to form Delaware state.

Nearly 4,000 of Delaware's population of only 37,000 enlisted in the Revolutionary War forces. A celebrated company was that led by Capt. Jonathan Caldwell, whose men brought with them spirited game chickens from the brood of a blue hen in Kent County. These men fought with such daring that they became known as the "Blue Hen's Chickens," thus earning for Delaware the nickname of the "Blue Hen" state.

Only one battle was fought on the soil of Delaware. This was at Cooch's Bridge, near Newark, Sept. 3, 1777. In 1786 Delaware was one of the five states that sent delegates to the Annapolis convention, of which John Dickinson of Delaware was elected president. At the Constitutional Convention, Dickinson was a leader in supporting the proposals for a new constitution to replace the Articles of Confederation, and he insisted that the states have equal representation in one House of Congress. On Dec. 7, 1787, Delaware ratified the new constitution, the first state to do so.

In the War of 1812 two Delaware leaders won outstanding victories. Captain Jacob Jones, commander of the *Wasp*, captured the British warship *Frolic* in October 1812. In September 1814 Capt. Thomas Macdonough defeated the British fleet on Lake Champlain. In the Civil War Southern sympathies led part of Delaware's men into the Confederate army. Over 13,000 joined the Union forces. About 10,000 served in World War I and about 25,000 in World War II. (*See also* chronology in Delaware Fact Summary; United States, section "Middle Atlantic Region.")

DELAWARE RIVER. Noted alike for its commerce, scenic beauty, and historic associations, the Delaware River flows through the rich and densely populated Middle Atlantic region of the United States. It rises in two branches on the westward slopes of the Catskill Mountains. They join in a united stream at the New York-Pennsylvania boundary. For about 70 miles it forms the line between these states, then turns southward to separate New Jersey from Pennsylvania and Delaware. Passing by Trenton, Philadelphia, Camden, Chester, Wilmington, and other industrial and commercial cities, it empties into the broad Delaware Bay.

The Delaware is 280 miles long from the junction of its branches to the head of the bay. The river is navigable as far as Trenton, N. J. Its chief tributaries are the Schuylkill and Lehigh rivers.

Most spectacular of its scenic stretches is the Delaware Water Gap near Stroudsburg, Pa. There the river pours through a narrow gorge in the Kittatinny range of the Appalachians. The gorge is about three miles long, and its sides rise more than a thousand feet sheer above the stream.

The river has played an important role in the development of its basin since colonial times. Its navigable lower reaches first welcomed the ships that brought settlers to Pennsylvania, Delaware, and New Jersey, then carried the commerce that for a time made Philadelphia the young nation's first port. The swift upstream waters bore log rafts from the timbered hills to build the downstream cities and the vessels in Philadelphia shipyards. Water power from the Delaware aided the early development of industry in the area. Today this rich industrial region brings in raw materials and transports many of its products on the river and the bay. Reservoirs on the headwaters impound water for the cities of the region. The Delaware River Port Authority and other commissions

set up by the states bordering the river are active in improving port and water supply facilit es and in building bridges

Delhi (*dĕl'ĭ*) India Through much of Ind a s long and troubled history its seat of government has been Delhi The city s site on the Jumna River commands the narrowest pass from the Ganges to the Indus Val ley Thus it is strateg cally located to control both the wet eastern and the dry western pla n and to serve as a center of transportation and trade

Eight cities have been bu lt here over the centuries as success ve dynasties and conquerors have set up their capitals New Delhi the present capital of the Republ c of India is an up-to-date modern city planned and constructed by the Brit sh when they ruled India In contrast old Delhi is a mixture of gorgeous palaces and mosques built by earlier rulers and slums where squalid houses huddle along mean crooked streets

Both cities have grown and become overcrowded s nce the partition of India and Pakistan in 1947 Old Delhi received hundreds of thousands of Hindu refu gees fleeing from Pakistan New Delhi swelled as the functions of the republican government called for thous inds of new officials The city is the year-around capital today whereas under Brit sh rule the govern ment was moved to cool Simla in the lower Hima layas in the summer Delhi New Delhi and their suburbs are incorporated in a Part C Indian state called Delhi (*see* India)

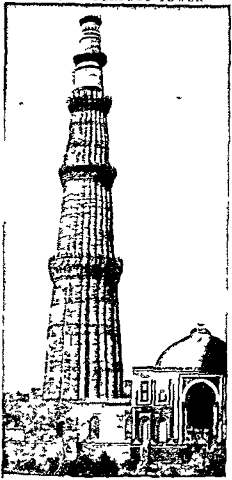
Through old Delhi runs Chandni Chauk or silver street once called the richest street in the world Both sides of th s wide avenue are lined w th t ny open faced shops Here are booths of the sweetmeat sellers where candies and small pastries are displayed in glistening copper pans Here sits the betel vendor He smears thick *pan* leaves with lime and a red paste called *kutta* adds chopped areca nut and with a little twist finishes the favorite confection that stains the lips a deep red

In the grain stores corn wheat rice and millet are sold to housewives along with spicy cardamom seeds and sweet oily sesame seeds Brassware pot tery and text le shops offer colorful wares and arti sans squat at looms or potter s wheels The m ngled odors of frying *ghee* (clarified butter) burning cow dung and leather swirl through the crowded streets

Monuments of the Mogul Era

The lofty city wall was constructed by Shah Jehan the great Mogul ruler and builder who is sa d to have found India in red stone and left it in marble He also bu lt the Red Palace now known as the fort and the magnificent Great Mosque completed in 1650 One of the largest Mohammedan buildings in the world the Great Mosque sits on a rocky elevation where its marble domes and graceful minarets are visible from afar (*see* Mohammed) The Pearl Mosque built by Aurangzeb Shah Jehan s successor as his private place of prayer is a gem in wh te marble Its three pearly domes are surmounted by inverted lotus blossoms and slender g lded spires

DELHI S PERFECT TOWER



The Kutb Minar near Delhi has been called the most perfect tower in the world It s 238 feet h gh and was begun about A D 1200 by Kutb ud D n the slave who became an emperor Those two oddly d fferent top stories were rebuilt by Feroz Shah

The most splendid buildings of Shah Jehan s palace are the Diwan i Am the hall of public audience and the D wan i Khas the hall of private audience In scribed upon the cornice of the Diwan i Khas is the Pers an text If there be a paradise on earth it is this it is this it is this

In this hall of marble columns g lded arches and jeweled walls once stood the famous Peacock Throne Its legs were golden and its base encrusted with rare stones Behind it stood two peacocks w th outspread ta ls closely inlaid with sapphires rubies emeralds pearls and other precious gems The canopy above was exquis tely enameled and supported by 12 emerald-set pillars When the Persian invader Nad r Shah sacked Delhi in 1739 he carried this mas terpiece to Persia Within the walls of the Red Pal ace there were once gardens and fountains kiosks

and harems of pure white marble, beauty and gorgeousness without end, of which scarcely a vestige remains, much of it having been done away with to make room for the British barracks.

Delhi was prominent in early days as the capital of the Mogul emperors. Its central position on the great east-west plain of India (almost the same distance from the two great eastern and western ports of Calcutta and Bombay) gave it both commercial and political importance. Through the centuries pilgrims and caravans have traveled over this great plain. The bazaars of Delhi became famous for their gold and silver filigree work, jewelry, woolen fabrics, pottery, and wood carvings. Today several railroads pass through the city, and modern cotton mills and factories exist side by side with handicraft industries.

Because of its ancient prestige, Queen Victoria chose Delhi as the seat of the great durbar (court) in 1877 when she was proclaimed empress of India. Similar ceremonies were held at the accession of King Edward VII and King George V.

In 1911 Delhi superseded Calcutta as the capital of India. At this time the small province of Delhi (573 square miles) was formed out of a corner of the Punjab province.

New Delhi, Capital of India

During the Indian Mutiny Delhi was captured by the mutineers in 1857, and much of the city was destroyed during the five months' siege by the British which followed. The British base during the siege was the famous Ridge, a rocky height of some 60 feet about a mile outside the city. The Ridge was chosen in 1912 as the site for a new capital, called New Delhi. When Great Britain freed the Indian Empire, in 1947, New Delhi became the capital of India.

Sir Edwin Lutyens laid out the plans for this "garden city." The top of the Ridge was leveled off to create a site for three main government buildings: the Viceregal Lodge, the Secretariat, and the Council or Parliament House. These main buildings are impressive in their classic style, with such oriental touches as domes and minarets cleverly combined. Broad tree-lined avenues lead from the government buildings down to the residential section below. Here many houses were built for government workers. The city covers about five square miles.

Population of Delhi (1951 census), 914,790; of New Delhi, 276,314.

DEL'PHI. In a gorge of lofty Mount Parnassus, overhung with towering cliffs, near the sacred fountain of Castalia—in the midst of perhaps the grandest and most awe-inspiring scenery in Greece, and (according to ancient belief) at the exact center of the habitable earth—was the famous oracle of Delphi. Here, it was believed, Apollo, the god of light, of poetry and music, and of prophecy, made known to men the will of Heaven; and here came inquirers from every part of Greece and from many other lands seeking his guidance.

In ancient days there was a cleft in the rock, whence issued volcanic vapors of strange potency. A priestess, known as the Pythia, having bathed in the fountain of Castalia and eaten of the leaves of the sacred laurel, took her seat on a tripod placed over the cleft, and inhaling the intoxicating vapors was thrown into an inspired frenzy or trance. The mystic words she uttered were taken down, put into verse form, and delivered to the inquirer as the revelations of Apollo. The oracles were usually expressed in obscure or ambiguous language and hence were capable of being interpreted in various ways. In the story of Croesus we read how such a response was given to this famous king before he went to war against the Persians (*see* Croesus).

No one who sought counsel at Delphi approached without gifts, and great treasuries were built to hold the offerings, often of pure gold or silver, presented by kings, states, and individuals. So many statues were erected that even after 500 of them were removed by the Roman emperor Nero, 3,000 remained. Recent excavations have laid bare the ruins of the great temple and many other buildings and many beautiful works of sculpture and thousands of inscriptions of historical value have also been found.

The oracle at Delphi was always consulted before any important step was taken by the ancient Greeks in affairs of state; and thus it exerted a powerful influence on the history of the Greeks. The common reverence for its utterances, and the Pythian festivals which were held at the shrine every four years, were among the chief influences making for unity in the political and religious life of the Greek world.

The Delphic oracle, though the most celebrated, was only one of several Greek oracles. The oldest was that of Zeus at Dodona, in Epirus, where Zeus was believed to speak through the rustling of the leaves of the sacred oak tree. There were also oracles in Rome, Egypt, Babylonia, and other countries.

DEMETER (*dē-mē'tĕr*). The early Greeks were much struck by the yearly change of the seasons, from the joyous and fruitful summer to the bleak desolation of winter. They found the explanation in the stories which they told of the goddess Demeter. She was the sister of Zeus (Jupiter), king of the gods, and was one of the greatest of their deities. The Greeks called her "grain-mother" or "earth-mother," and worshiped her as the goddess of agriculture and of civilized life.

According to these stories, there was at first no winter but the earth smiled green and fruitful in perpetual summer. But one day, while Demeter's lovely daughter Persephone was gathering flowers in a meadow with her playmates, the earth opened and Hades (Pluto), the god of the dead, appeared and carried her off to be his queen in the world below. Demeter was inconsolable, and torch in hand she sought her missing child throughout the wide world. All that year not a stalk of grain grew, and man would have died of hunger if Zeus had not persuaded Hades to let Persephone go. But she had eaten a pomegranate seed with Hades, and so could not stay

away forever In the end it was arranged that Persephone should spend two thirds of every year with her mother and the heavenly gods and the rest of the year with Hades in the world of the dead So as a result of this arrangement during spring summer and autumn earth blooms and bears fruit and during the winter the life of vegetation sleeps buried underground At Eleusis in western Greece the Greeks held an annual festival in honor of Demeter with secret ceremonies Those who were initiated into these Eleusinian mysteries found a deeper meaning in this myth To them it held forth the promise of a future life beyond death

The Romans worshiped Demeter under the name of Ceres which gives us the word cereal and called her daughter Proserpina

GOVERNMENT *by the* VOTES *of the* PEOPLE

DEMOCRACY The word *democracy* comes from two Greek words meaning people and to rule Thus a democracy means literally rule of the people It is applied to any government in which the people retain supreme power and exercise that power directly or indirectly through their elected representatives

Throughout the history of civilization people have struggled continuously to obtain and keep the power to govern themselves In some ages this struggle was more successful than in others Sometimes democracy was won by a particular people only to be lost again During all this time however there has been slow but steady progress toward democratic government for more and more people

The Earliest Forms of Government

The history of civilization begins in Western Asia and Egypt about 5 000 years ago At that time democracy was almost unknown Government was by *autocracy*—the unrestricted rule of a single person

In the great Asian nations such as Babylonia and Assyria an absolute monarch ruled without any legal limitations upon his power He made laws by his own decrees and had the power of life or death over his subjects The only restraints upon him were custom the fear of arousing rebellion and the power of the great nobles Some of these rulers such as Sennacherib were bloodthirsty and cruel Others such as Cyrus were moderate and wise Even among the Biblical peoples of Palestine and other small nations autocracy was the rule

In the more backward parts of the world some tribes or clans were organized in such a way that government was by the heads of families This was rare however Usually the people were ruled by a chief or a king sometimes with the aid of a council of elders Throughout this period the voice of the whole people was seldom heard (*See also* Family)

Democracy in Ancient Greece

The first development of democracy in any important sense occurred in the city states of ancient Greece These were tiny nations that usually covered less than a hundred square miles Ten thousand free people was a large number for such states Thus all the freemen could meet in a general assembly to speak and vote This was the simplest form of democracy There was no need for representative democracy in which one man speaks for many others

At first these city-states were ruled by kings The kings had to listen to the opinions of the Assembly After a time—in Athens as early as 700 B C—the kingship was replaced by a rule of the principal families (*See also* Athens) This form of government is called an *oligarchy* When the people demanded a greater and greater share in the government democracy steadily gained strength By the time of Clisthenes (about 500 B C) the people of Athens had gained practically full control They elected their own magistrates and made their own laws

The Athenian Assembly

In Athens which was the largest city state in Greece all final authority was placed in an assembly or *ecclesia* of the freemen There laws were passed generals and magistrates were chosen and a great deal of the business of the state was transacted There was a Council of 500 members but its principal business was simply to prepare legislation for the Assembly to act upon During times of peace especially in the early days the Assembly took great pains to prevent any one man from becoming supreme Terms of office were kept short seldom exceeding a year for any officer the military power was usually divided among a number of generals all equal in rank and some of the principal civil officers were chosen by lot so that the weakest citizen had the same opportunity as the strongest Political parties in the modern sense played no part in the government The Assembly was a great school of oratory and of the art of managing large bodies of men and Athens became known for its skillful political leaders

When the leaders who gained the favor of the Assembly were able and upright this democratic government of the Greek city-states worked well Under a great man such as Pericles or a just man such as Aristides the city-state prospered (*see* Aristides Pericles) At its worst the Assembly was too much like a fickle mob and it sometimes yielded to evil men such as Cleon or to dangerous men such as Alcibiades Such demagogues could assume control too easily under this system Moreover it lacked the power of healthy endurance When a great monarchy arose in Macedon a first under Philip and then under Alexander the Great the democracies of Greece crumbled before its onslaught (*See* Greece)

Roman Struggle for Freedom

Rome also was at first ruled by kings As the city grew however its population came to include many outside of the original tribe which had founded it These outsiders were denied political equality and other rights The result was a series of struggles in which the people demanded a fairer more democratic

form of government. The kingship was overthrown in 510 B.C. Thereafter, two consuls were chosen each year by an assembly of all the fighting men, the *comitia curiata*, to administer the laws. But even then the government was not a true democracy, for most of the members of the *comitia curiata* were "patricians" (the wealthy classes). The *comitia curiata* divided its power with the Senate, which was a smaller body of the aristocracy, each member holding office for life.

The common people of Rome, the *plebs*, made determined efforts to widen their rights of self-government, and gained some victories. Beginning in 339 B.C. the popular assemblies held for a period the full right of making laws. But Rome never achieved as much democracy as Greece. The Senate clung tenaciously to its power, and during the long struggle against Carthage—the Punic Wars—it became much the most powerful body in the nation. The senators controlled foreign affairs, the army, and the finances, and they really ruled as an oligarchy. Gradually the republic decayed. As the Roman armies conquered more of the world, powerful military commanders arose who held the supreme authority in the state. The Senate was naturally jealous of these commanders. But, finally, the greatest of them, Julius Caesar, overthrew the senatorial power and established the Empire. Except in the German forests and other wild areas, democracy appeared dead. (*See* Roman History.)

The Free Cities of the Middle Ages

Centuries passed before it revived again, for in the early Middle Ages democracy as we know it remained practically unknown. The rise of feudalism meant the rise of an aristocracy. Men yielded obedience to noblemen who had inherited their authority, or gained it by war and conquest. (*See* Feudalism.) But gradually a spark of democracy in the towns and cities of Western Europe began to kindle into a little blaze. These towns, in England, France, and Germany, were at first usually governed by some feudal lord or great churchman. But many of them came to be filled by artisans and merchants who were intent upon peaceful trade and money making, not upon war. In city after city the tradesmen and workmen began demanding charters to guarantee their political and economic rights. The kings, noblemen, and abbots struggled in vain against this trend, for the determined citizens always won.

By 1250, there were towns all over Europe which were wholly or partly free from their old feudal lords, though not from the kings; and they had gone far on the road of true democracy. Their qualified citizens, the burghers or burgesses, elected aldermen who made the laws and mayors who enforced them. But there was one important difference between most of these medieval cities and those of the modern world. The individual merchant, iron-worker, glassmaker, or weaver counted for little; it was his trade or calling that was important. In the typical free city of this period the government was based upon the different trades, or industries, such as the merchant guilds, and the various craft guilds, not upon wards or other geographical divisions (*see* Guilds).

Rise of Democracy in England

It was in England that democracy reached its fullest development. The English people had inherited some striking democratic institutions from the Teutonic invaders who had colonized Britain. In the very dawn of history these Teutonic tribes are found governing themselves in village communities by meetings of all the freemen. In England, such self-governing communities in early times combined into "hundreds," which were governed by a "hundred-moot" or meeting, made up of the priest, the reeve (steward), and four men from each township in the hundred. Above this was a general "folk-moot," a tribal or national council. In time, all England became a single Saxon kingdom, and the king was then assisted in ruling by a select national council of the chief men, called the "Witenagemot."

After the Norman conquest the towns rapidly became important, and the old Teutonic spirit of democracy revived in them. Henry I, who ruled 1100-1135, granted London a charter which was regarded as a model by other towns. Many of them demanded similar instruments, which Henry granted. After his death, Richard I, who was anxious to obtain money for his Crusade, sold charters to other municipalities.

The spirit of democracy in these places was alert and vital. In London, for example, special bodies of the citizens frequently came together in crowded borough meetings to elect aldermen and in guild meetings to transact business for their trades. When the bell of old St. Paul's clanged loudly, they all met in a single great town meeting, with their aldermen presiding. Every townsman could claim the right to be tried by his equals in the town court or "hustings." When any danger threatened the city the townsmen mustered their own army, and delivered the banner to their chosen captain. As the years passed, the various town governments became as powerful as the noblemen who ruled great domains, or the churchmen who controlled many parishes.

Effect of Magna Carta

Meanwhile, there was a trend toward democracy in the English nation as a whole. By force of custom, law, or local charters, both the people and the noblemen, or barons, gradually obtained many rights. When King John, a weak monarch, tried to override them, the barons compelled him in 1215 to sign the Great Charter (Magna Carta). This protected the poor man in his right to justice and to his own property, while it also confirmed the privileges of the town. "Let the city of London," said the Great Charter, "have all its old liberties and its free customs, as well by land as by water. Besides this, we will grant that all other cities, and boroughs, and towns, and ports, have all their liberties and free customs" For centuries men looked back to the Charter of Runnymede as a landmark of English freedom. (*See* Magna Carta.)

Another great advance in democracy was made in 1265 There was already a parliament, but the only representatives in it were the barons the bishops, and the knights of the shires The knights had been summoned only occasionally since they were first called by King John in 1213 In 1265 Simon de Montfort, who was regent, called together a parliament in which the towns and boroughs were represented, each being entitled to two members It was a "packed assembly, but it marked a distinct turn in the history of parliament A little later, in the "model parliament" of 1295, the representation of the towns was made permanent and regular

By the middle of the 14th century, Parliament had separated into two bodies—the hereditary House of Lords (with the bishops) and the House of Commons which was made up of town members and knights of the shires The House of Commons was a great new instrument of democracy (See Parliament)

The Power of the Parliament

In other countries of Europe parliaments sprang up in much the same way Each of the early kingdoms in Spain had a "Cortes" and members chosen by the towns sat in Leon as early as 1188 In France, there was a "States-General," in which the burgesses of the towns also had representatives In Sweden there was the "Riksdag," to which even the peasant farmers sent their own members

But in none of these countries did the parliament become so important as in England By the time of Cromwell, in the 17th century, the House of Commons had grown strong enough to overthrow the king and govern the whole country A little later ministerial government was established, that is, government by men whom Parliament and not the king controlled In the 18th century the House of Commons lost ground for a time It was rather an aristocratic body than a democratic institution, and it fell under the influence of the king But in the 19th century all this was completely changed By a series of great reform acts culminating in the woman suffrage act of 1928 practically every adult person was allowed to vote for members of the House of Commons, and that body became one of the most truly democratic *legislatures in the world*

American Democracy Founded

During the 19th century, democracy or "government of the people, by the people, and for the people," seemed to be sweeping the greater part of the civilized world Even before the Revolution the English colonies in North America had highly democratic forms of government Two of them Rhode Island and Connecticut, governed themselves almost entirely and were among the freest communities on the globe After the Revolution the United States rapidly rose to a preeminent position as a democracy At first, the government had aristocratic features but, in the time of Jefferson and still more in that of Andrew Jackson, the people established the principle that every grown man should have a vote, and the right to hold office

American political philosophy and institutions were strongly influenced by the French In France the revolution of 1789 resulted in the overthrow of the despotic Bourbons and the ultimate establishment of a democracy Both the French and the American democracies took the form of a *republic* that is, in the modern sense, a free, popular government in which there is no hereditary ruler or ruling class Following the examples of France and the United States, most Latin American countries early in the 19th century became republics But centuries of colonial subjection were poor training for self rule and so, in some of these new republics democracy was slow to develop

As democracy spread, it was most commonly associated with the republican form of government But the second type of democracy—the constitutional monarchy—also took root in some countries In Denmark, Norway, and Sweden, as in England, the rulers abided strictly by constitutional restrictions of their power, and the freedom loving peoples of those nations developed democratic institutions of the first order

Years of Promise for Democracy

The chief stronghold of autocracy remained in central and eastern Europe When the first World War resulted in the defeat of Germany and Austria Hungary, many hailed the peace as the opening of a new era in which democracy would everywhere prevail

There were indeed many promising events to support this hope In Germany and Austria the overthrow of the monarchy brought republics with democratic forms of government As the vast Russian Empire disintegrated, there emerged the compact new republics of Finland, Esthonia, Latvia, and Lithuania From the Baltic, south across the young republic of Poland, and into the traditionally despot-ruled Balkans, a new spirit of democracy appeared Throughout the British Empire there was greater self-rule Even in Asia democratic concepts began to spread

Rise of Modern Dictators

But even as democracy was thus adding new nations to its fold, its way of life was being challenged by rival systems of government In Russia the overthrow of the czarist régime brought a brief period of democracy, but a communist revolution in 1917 soon established a "dictatorship of the proletariat" (*see* Communism) In Italy the parliamentary system, attacked on all sides, finally succumbed in 1922 to the fascist dictatorship of Benito Mussolini (*see* Fascism) Other new democracies came under the sway of "strong men," who abolished all opposition and ruled as despotically as any king (*see* Dictatorship)

The full menace to democracy of these "totalitarian" systems did not become evident, however, until the National Socialists under Adolf Hitler took power in Germany in 1933 Swift action, rigid discipline, and construction of a great military machine—these enabled Nazi Germany to force concessions from the democracies, who sought to hold the peace Extension of *German aggression in 1939 plunged the democracies*

into the second World War (*see* World War, Second). Later Hitler attacked Russia, so the Communists fought on the side of the democracies. The Fascist nations (Germany, Italy, and Japan) suffered defeat. But the democracies feared the rise of new dictators in lands that had known little freedom. To guard against this, they launched programs in Japan and western Germany to teach the people democratic ways.

Communism Confronts Democracy

Russia emerged from the war one of the world's two great powers. Its army formed a solid wall across Europe from the Baltic Sea to the Adriatic. East of this "iron curtain" only Greece remained outside the Russian orbit. Communists dominated the governments of Yugoslavia, Czechoslovakia, Poland, Hungary, Bulgaria, Rumania, and Albania, and gained strength in Finland. The Baltic republics (Latvia, Lithuania, and Esthonia) became republics of the Soviet Union. Native Communists seized vast China. In countries outside the Russian sphere, the Communist party sought to overturn democratic governments.

The Russians claim that their system of government is the only "true democracy." But, like the Fascists, Communists consider the state more important than the individual. The Soviet Union continued to be governed by a rigid dictatorship. It did not permit freedom of speech or freedom of the press. It allowed only one party, the Communist party. It insisted that all citizens go to the polls; but the ballots contained only a single slate of candidates. The government tolerated no opposition to its policies.

In contrast, democratic government rests on a system of two or more political parties. Minority parties are not only tolerated; they take part in the government. The democratic system rests upon freedom of thought and speech, and respects the dignity and worth of each individual. To guard the rights of the people, democracy imposes restraints even on the will of the majority. The Constitution of the United States, for example, limits the powers of the government; and the bill of rights, which it contains, guarantees to the people freedom of speech, freedom of the press, freedom of assembly, and freedom of religion.

Kinds of Democratic Government

The processes of democratic government have been evolved slowly and are continually being changed to meet new conditions. For example, self-government may take the form of *direct democracy* or of *representative democracy*. Direct democracy is government by all the citizens meeting together. The growth of population has made this impossible except for little units of local government. It exists in town meetings in parts of the United States and in the assemblies of the Swiss cantons. But no large nation can be ruled by direct democracy.

Of the representative democracies there are several types. One is the parliamentary democracy of Great Britain, and of Canada and the other British dominions. Another type is the presidential system which prevails in the United States and among South American nations. A third, as yet restricted to one country, is the executive council system of Switzerland. Each of these systems has its advantages and disadvantages, but the preference of the world in recent decades has swung strongly toward the parliamentary system.

Under the parliamentary system, which was invented in England, the government is carried on by a popularly elected legislature and by a cabinet which is in effect selected and dismissed at will by the legislative majority. Whenever the parliament changes its opinion upon any great issue, or whenever the country elects a new parliament of changed party complexion, one cabinet resigns and another is chosen. In this system, the will of the people usually finds immediate and vigorous expression. Moreover, it is adapted to bring able leaders to the front. In a parliament, the best orators and the most earnest and aggressive statesmen rise to be cabinet ministers. But the parliamentary system operates very clumsily where there are three or more strong parties, so that a cabinet finds it hard to obtain and keep a majority behind it.

In the presidential system the government is carried on by a legislature and president, who are largely independent of each other; the president is responsible not to the legislature but to the people, and he holds office for a fixed term of years. This plan produces greater stability and safety than the parliamentary system, for the president and the legislature tend to check each other. But such a government is often slow to act, and critics say that second-rate men, controlled by professional politicians, have a better chance than first-rate leaders of becoming president.

The Swiss Plan

Under the Swiss plan, there is a legislature elected by the people, which in turn chooses a small administrative council to execute the laws. This council is not a cabinet, for it holds office during a fixed term, and its members have no seats in the legislature. It occupies a position intermediate between the British ministry and the American president and his cabinet, though it is much less powerful than either. The Swiss plan appears to work well; but Switzerland is a small country, with an exceptionally intelligent people, no extremes of wealth or poverty, and few great problems. It is not certain that the same government would do so well in large and complex nations.

In all the great democracies, whatever their type, some common perils and difficulties have arisen. In all of them government has to be carried on by the aid of parties, and party passions and hatreds often rise dangerously high (*see* Political Parties). They cause unwise legislation, and sometimes even civil wars. Another danger is the evil use of money in popular government. Where there are great masses of voters to be reached, as in all large democracies, huge sums of money must be spent in political campaigns. Too often part of it is used for bribery or other improper purposes. Another defect lies in the difficulty of telling just what popular opinion is. In democratic self-government the will of the majority is sup-

posed to rule, yet when elections are held a great many confusing issues are often talked about at once, *and it is hard to say just what the people have really* decided Perhaps the greatest danger of all is that in a democracy of tens of millions of people the government may get out of touch with the masses The men who are elected to office may try to please bosses and machines instead of the public, or else try to please the voters with popular but unsound measures

All these dangers can be met, but only by constant vigilance And indeed, it is one of the great benefits of democracy that it tends to keep the people alert, to train them in self-reliance, and to make them realize that above all other guarantees must stand sound systems of education, so that they will know how to find and face real issues intelligently

DEMOSTHENES (*dē-mŏs'thē-nēz*) (about 383–322 B C) If any of the Athenian friends of the youthful Demosthenes had foretold that he would become the most famous orator not only of Greece but of all history, the prediction would have moved those who heard it to derisive laughter

"A great orator, indeed!' they would have replied "Why, Demosthenes is the least likely lad in all Athens for public speaking Look at him! He is a puny, spindling fellow. He is clumsy and awkward, and one shoulder is higher than the other His voice is thin and weak, and he has an impediment in his speech A great orator? Nonsense!'

But a great orator Demosthenes was determined to be, and a great orator he became Even to this day, the student who wishes to master the art of eloquence studies the speeches of Demosthenes as the supreme masterpieces of any age Perhaps one impulse that moved the young Athenian to entertain this ambition was the desire to obtain justice against his two cousins, who had mismanaged the goodly estate his father had left him, and had turned over to him only about one-seventh of what he should have received when he came of age At any rate Demosthenes did plead his case against one of his unjust guardians *in later life, and won a verdict for damages*

When he first tried to speak in the public assembly, he was only laughed at But Demosthenes had the kind of will that triumphs over all obstacles To learn to articulate more distinctly, it is said that he practiced speaking with pebbles in his mouth, and to strengthen his voice he declaimed on *the seashore* amid the roar of the waves or ran up hill as he recited To overcome his awkward habit of *lifting one shoulder higher than the other, he hung* a sword so that it would touch his shoulder if he raised it He fitted up a room in a cave, where he could study and practice without interruption Often he sat up at night, writing and rewriting his speeches by the glimmer of an oil lamp A man who was jealous of him once referred to this with a sneer, saying, "Demosthenes, *your speeches smell of the lamp*"

Success crowned his efforts, and Demosthenes at length rose to popularity and power, just at the time when a great danger threatened Athens King Philip, who ruled Macedon, just north of Greece, was beginning those conquests which in the end made him master of Greece Demosthenes, foreseeing the danger, urged his countrymen in one eloquent appeal after

DEMOSTHENES
"The Greatest Orator of All Time"

another *to arise and preserve their freedom His* powerful orations against Philip were known as "philippics," and they became so famous that today any impassioned denunciation or criticism is called a "philippic"

Only when it was too late did the Athenians heed the warnings of Demosthenes Darker days followed for the great orator The pro-Macedonian party, which *had for its spokesman Aeschines, an orator* second only to Demosthenes, obtained his condemnation on a false charge of taking a bribe *He was fined* and thrown into prison, from which he fled into exile When Alexander the Great of Macedon *died,* Demosthenes was recalled and led a *last attempt to throw off* the Macedonian yoke Defeat put an end to the hopes of the patriots, and Demosthenes had to *flee for his life When overtaken by his pursuers, he* begged leave to write a letter For a few moments he was seen to chew a pen as was his habit when writing or thinking But in the *hollow of that reed he kept* poison for just such a crisis *Soon he began to tremble,* and rising up, he tottered and fell dead

Demosthenes' greatest oration, entitled On the Crown', was delivered in 330 B C It was a review and justification of his public life, in answer to the criticisms of his enemies *and is the most splendid example of ancient oratory* that has come down to us

STURDY LITTLE DENMARK *and Its* PROGRESSIVE PEOPLE

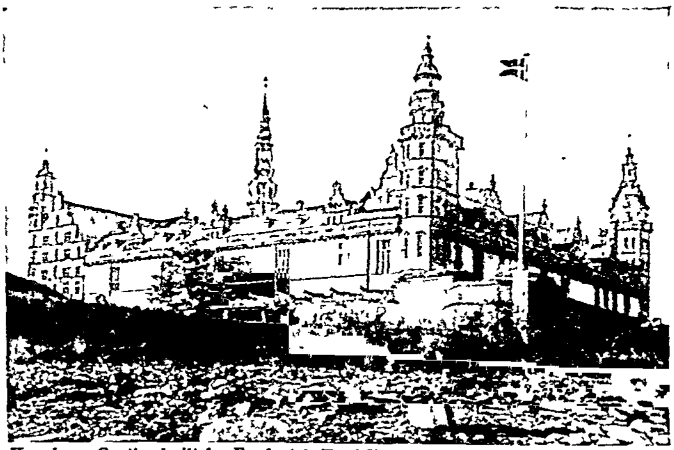
Extent.—Area, 16,568 square miles (11,408 in Jutland peninsula, the remainder in islands). Population (1950 census), 4,281,275.
Products.—Wheat, oats, rye, barley, potatoes, root crops; livestock, hides, and dairy products; cod, haddock, and other fish; porcelain, paper, wooden clocks, electrical equipment, automobiles.
Cities.—Copenhagen (capital, 768,105); Aarhus (116,167); Odense (100,940); Aalborg (79,806); Randers, Horsens (over 35,000).

DENMARK. The fearless spirit of the ancient Viking sea warriors persists in the Danish people. But long ago they abandoned the warlike attitude of their ancestors and have used industry, intelligence, and unity of purpose as their modern weapons in developing and preserving their country.

These qualities have strengthened Denmark in both peace and war. They held it firm through five years of German occupation and persecution in the second World War. When the Germans invaded in 1940, the helpless Danes surrendered at once and never declared war; but no nation organized a more effective Underground resistance. Danes blew up power plants, railways, factories, and warehouses, and harried Nazi occupation troops in every corner of the tiny nation.

Denmark is made up of a long peninsula called Jutland; two large islands, Fünen (Danish *Fyn*), and Zealand (*Sjaelland*); and some 500 smaller islands which dot the entrance to the Baltic Sea. A strip of land about 30 miles wide joins Jutland to the German Plain at the south. The long sandy finger at its northern tip is 70 miles from Norway, across the Skagerrak. The North Sea lies to the west. To the east, between Denmark and Sweden, stretches the narrow Kattegat—the entrance to the Baltic Sea.

HAMLET'S CASTLE AT ELSINORE



Kronborg Castle, built by Frederick II of Norway and Sweden about 1580, is the scene of Shakespeare's play 'Hamlet'. It is near the seaport of Helsingör (in English, Elsinore). Until 1857 it was a customs station, where Denmark collected dues on vessels passing the entrance to the Baltic Sea.

The area of the kingdom is only 16,568 square miles, about twice that of Massachusetts. Its only dependencies, since Iceland became an independent republic in 1944, are the Faroe Islands and Greenland.

A Survey from West to East

The Jutland peninsula comprises two-thirds of the area of the country. The western side is a broad plain of moor, heath, and sand, swept by winds and rimmed at the coast by dunes and low white cliffs. This part of the peninsula was all waste land at one time. Due to the efforts of the Danish Heath Society, a large part of it is now producing grains, sugar beets, pasturage, and pine trees. The middle of the peninsula consists of a wide strip of irregular hills. The eastern shore is fertile and wooded, with a coast indented by shallow fiords, each one with a small town or fishing village at its head.

The harbor of Frederikshavn at the northern end of Jutland is the sailing point for passengers and goods bound for Sweden. Aarhus, halfway down the east coast, is an important seaport and Denmark's second largest city. The only city of any importance on the west coast is Esbjerg, a shipping point for the quantities of food exports that go to Great Britain.

The islands are fertile spots, alike in formation, with low hills, tiny lakes, and sandy beaches. Even the smallest ones are richly green and wooded by the typical beech trees. The soil is of glacial origin, constantly moistened by the damp sea winds and fogs.

Just to the east of Jutland, across the Little Belt, by ferry or over the half-mile bridge, is the garden island of Fünen. Its largest city, Odense, is famous as the birthplace of the beloved writer of charming fairy stories, Hans Christian Andersen.

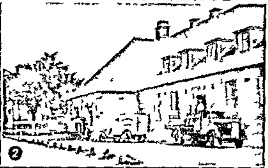
East again from Fünen, 10 to 15 miles across the Great Belt, lies Zealand, the largest of the islands and the seat of the capital city of Copenhagen. The city is the country's largest port, its only important industrial center, and the home of nearly one fifth of Denmark's population (*see* Copenhagen).

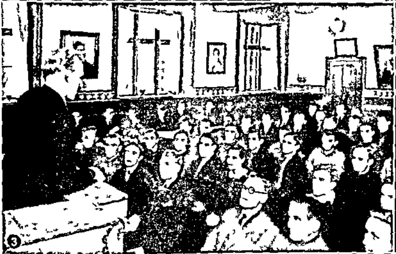
The two-mile Storstrom Bridge links Zealand to the southern island of Falster. West of Falster is Laaland Island; east is Moen. Some 100 miles further east is Bornholm Island, site of Denmark's deposits of brown coal and the kaolin used in making porcelain. These deposits were long thought to be Denmark's only minerals, but great salt beds were found elsewhere in 1946-48.

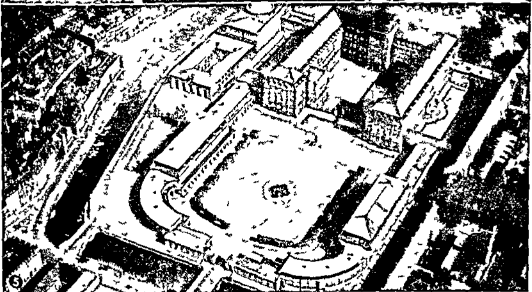
Denmark a Farming Nation

The Danes have always been a seafaring people but in recent years at least a third of them have been engaged in agriculture and dairy and stock farming. Although much of the land is difficult to cultivate, the soil is extremely fertile. The combination of moderate climate, good soil, skillful scientific farming and long-range government aid has made Denmark one of the richest agricultural countries in Europe. Most of the farmers are small landowners, as the laws forbid the merging of small farms into

DENMARK LEADS IN THE ARTS OF PEACE







1 A typical Danish country church, on the island of Fünen 2 A coöperative dairy on Zealand 3 A rural folk school in session *These schools help make Denmark* a highly educated nation 4 A statue of Bertel Thorvaldsen the great sculptor leaning on his figure of 'Hope It is in the Thorvaldsen Museum Copenhagen The museum contains the sculptor's tomb *and most of his original works.* 5 The Christiansborg Palace in Copenhagen, where the Danish Parliament assembles.

larger units. The fact that each man, with his family, is working for himself on his own land has done much to create the spirit of independence and democracy characteristic of the Danes.

Denmark has the most successful system of rural coöperatives in the world, with a membership of nearly nine-tenths of the farmers in the country. The cooperative societies pool capital and buy farm machinery, handle the marketing of the milk, butter, eggs, and bacon, in addition to keeping themselves informed about the best agricultural methods.

The prosperity of the Danes is based chiefly on pigs, cows, and chickens, which provide the bacon, eggs, and dairy products for their export business. The crops of grain and vegetables are now raised almost exclusively for local consumption and for feeding the livestock. Until the middle of the 19th century, grains and cereals were Denmark's largest exports. At that time, American competition made it impossible for them to market these products profitably, and many of the farmers were ruined in the depression that followed. Then they changed to stock and dairy farming, and not only recovered their export business, but increased it.

Fishing and Other Industries

Fishing continues to be a profitable occupation for many Danes. Some of the fishing villages are shining and modern; others are made up of rusty thatched huts that seem to have been left untouched since the old feudal days. But all along the coast, the fishermen are hard at work with boats and nets to bring in the cod, salmon, haddock, herring, and other fish that make up a large part of the country's food and exports.

About a third of the Danish people are engaged in the manufacture of beer, margarine, beet sugar, bicycles and other machinery, and in fish canning. The shipyards where Diesel-powered vessels are built are as modern as any in the world.

Life in City and Country

The cities, even around the port districts, are so clean that they look as though they had been carefully scrubbed every night. The buildings and streets are modern and well constructed, and the most popular method of transportation is the ever-present bicycle. Here and there, in the midst of the modern buildings, rise some fine old castles, most of them built in the 16th century. The most notable one is Kronborg Castle, near the seaport of Helsingör, which Shakespeare immortalized as Elsinore in 'Hamlet'.

The Danes seem to have discovered a fine philosophy of living well and vigorously. They are happy, friendly, and helpful, whether met on the city streets or in the fields. The farmer and his family do most of the work on the land, and his home is equipped with central heating, telephone, and refrigeration. Most of the farms have low, white-plastered buildings, with either thatched or red tile roofs, and are built around small courts. In front of the house, a neatly fenced flower garden flaunts its gay colors, and a little summerhouse offers an outdoor dining room for use in the brief summer months, as the sun-loving Danes never stay inside when the weather is good. During the winter, the housewife busies herself with lacemaking or weaving, and a glance inside the homes shows that nearly every family boasts at least one painter whose works decorate the walls.

Education and Social Welfare

The Danes have no racial problems, as they are almost entirely of the same northern stock, tall and blond. But neither have they any racial prejudices. There are no extremes of wealth and poverty, and there is no illiteracy, as education is compulsory. The splendid high schools founded by the famous writer and teacher, Bishop Nikolai Grundtvig (1783–1872), were the foundation of the system of folk schools now established throughout the land. Working on the principle that understanding and love of their country would stimulate in his people an active interest in their government, Bishop Grundtvig instituted schools for the study of Danish history and folklore, and of modern methods of democracy. These schools have now become also important factors in adult education, and are maintained by the Workers' Educational Alliance.

Denmark has kept in advance of most other countries in social legislation. Its present form of government, a constitutional monarchy with legislative powers delegated to the parliament (Folketing), was founded in 1849. Before the end of that century, Denmark's laws had provided for old-age pensions, health and hospital insurance, and trade unions. The government also maintains the National Health Service, whose members give instruction on all matters of hygiene, nutrition, and kindred subjects. Living standards are so uniform that it has been possible to organize these measures along similar lines for all the people alike. The same uniformity obtains in religion, as about 85 per cent of the people belong to the established Lutheran Church.

There are two universities in Denmark: the Copenhagen University was founded in 1479 and the University of Aarhus was opened in 1933. Since the days of Tycho Brahe, famous 16th-century astronomer, Denmark has produced many distinguished scientists. Perhaps the best known of them is Niels Bohr, world authority on atomic theory (*see* Bohr).

The History of Denmark

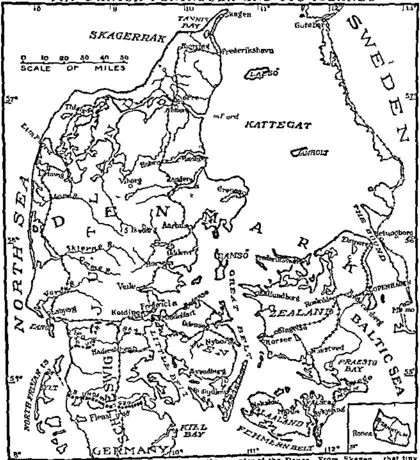
The entire ancient history attributed to the Danes previous to the Viking period is founded on tradition and sagas. One fact that is well established is that all the Northmen were savage and warlike and loved fighting for its own sake. The Vikings were pirates and freebooters, whose galleys sailed to the shores of all the countries of the known world, and were a scourge to all the lands within their reach.

Although the "wild Danes" were mentioned in a document written in the 6th century, the first authentic historical record of their people is about A.D. 800. From 800 to 1042 they were constantly raiding the English shores, and it is recorded that it was the Danes who conquered and colonized southern England (*see* Canute).

In 826 the missionary monk Ansgar had brought the first Christian teachings to the wild northland, but the real Christianization of Denmark was not accomplished until the Viking period ended, in the reign of Harold Bluetooth, 960

Under King Canute, Norway was conquered After Canute s death, the kingdom was in a state of chaos, with bitter jealousy and fighting among the nobles The free Danes were forced to accept a feudal system, under which they became serfs, and poverty and dissatisfaction were widespread With the reign of Valdemar I, 1157–82, Denmark recovered its power The Danes conquered northern German territory as far as Hamburg and Lubeck, and the Baltic was Denmark's sea After the reign of Valdemar II, 1202–41, the whole political structure of the nation again became disintegrated through internal strife and religious differences, and it was not until the reign of Valdemar IV, 1340–75, that the country became reunited This monarch again made Denmark a great Baltic power His work for the welfare of his people was carried on by his famous daughter Margaret

THE DANISH PENINSULA AND ITS ISLANDS



It is a rich and pleasant land for the most part, this country of the Danes From Skagen, that tiny tongue of sand curving out into the seas down through the lonely moors and heaths of Jutland and throughout that group of great islands that nearly close the mouth of the Baltic order and prosperity reign The island of Bornholm shown in the square at the lower right hand corner, lies a considerable distance to the east in the Baltic The map shows the portion of Schleswig which was reunited with Denmark after the first World War.

Union with Norway and Sweden

It was during Queen Margaret's reign that the Kalmar Union was formed in 1397 This agreement, uniting the three Scandanavian countries, Norway, Sweden and Denmark, left authority with each nation to manage its own affairs but united them against aggression Sweden was never satisfied with the Union, as Denmark was the powerful member of the group, and after many quarrels, it withdrew in 1532 Norway and Denmark kept the Union until 1814, when the Peace of Kiel ceded Norway to Sweden

Denmark enjoyed fifty years of peace until 1864, when it was attacked by Austria and Prussia and lost the provinces of Schleswig and Holstein After that war, the Danes were at peace until the German invasion in 1940 In the intervening period they built up their present strong democratic structure In the first World War, the country remained neutral although its sympathies were with the Allies After Germany's defeat, a plebiscite gave back to Denmark the northern third of the province of Schleswig

Resistance to German Occupation

In April 1940 disregarding its nonaggression pact with Denmark, Germany sent in its troops King Christian X asked his people not to resist He remained in Copenhagen, regarding himself as a prisoner and refusing to appoint a new cabinet, as the Germans wished him to do Later on, all semblance of authority was taken from the Danish government and the people's trade, homes, and lives were under the heel of the

invaders. Sabotage against the Germans increased. Trains were wrecked, manufacturing plants were blown up, and general strikes were called.

Denmark came out of the war in better condition than other nations occupied by Germany. The Danes had seen few battles and little bombing. In 1947 Frederick IX succeeded his father, Christian X, as king. Denmark joined the European Recovery Plan in 1948 and ratified the North Atlantic Treaty in 1949. By 1953 Denmark had sufficiently recovered from the war to end economic aid from America. In 1953 it amended its constitution and changed from a two-house parliament to one body, the *Folketing* (Peoples' Assembly). The law of succession was changed to permit 13-year-old Princess Margarethe, daughter of Frederick IX, to be heir apparent. Greenland was raised from the status of a colony and given representation in the Folketing.

REFERENCE-OUTLINE FOR STUDY OF DENMARK AND ICELAND

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DENTISTRY. Artificial teeth and gold mountings existed in Roman days, but the care of the teeth was crude, and it was not until the middle of the 19th century that dentistry became recognized as a separate and important science. Even for years after that dentists dealt chiefly with filling cavities, extracting teeth, and making "false" teeth.

To the members of the profession in the United States belongs the honor of having first preached the all-important doctrines of dental hygiene, which includes the proper care of the teeth and mouth to prevent infection and decay. It is generally recognized today that many diseases are caused by germs which gain entrance to the body through neglected teeth and gums. An apparently healthy tooth, for instance, may have at its roots a painless abscess, which constantly infects the blood, causing inflammations of the bone or nerve sheaths, as in rheumatism, sciatica, etc.

The training of the modern dentist, therefore, requires more than mere mechanical skill. He must have a complete knowledge of the anatomy of the mouth, the structure of bone and flesh tissues, and the diseases which affect them. He must be a competent surgeon in his field and have a sufficient knowledge of general medicine to diagnose ailments due to defective teeth. For special work, a practical knowledge of anesthetics and of the use of the X ray is required.

So important has proper dental work become that many large cities maintain dental clinics where children particularly can receive the necessary care, and dental inspection is often carried out in the public schools at municipal expense. Attention to mouth hygiene has been proved to result in weight increase, higher disease resistance, better school attendance, more energy, and higher scholarship.

The degree conferred upon students who have completed the required course in dentistry is designated in most institutions as Doctor of Dental Surgery (D.D.S.), though some schools use the title Doctor of Dental Medicine (D.M.D.). (*See also* Teeth.)

DENVER COLO To the east of Denver Colorado s capital the high plains stretch for miles until they merge with the prairie in Kansas To the west are the foothills of the Rockies which turn suddenly into the high Front Range less than 15 miles from the city From here a person can see Longs Peak to the north and Pikes Peak to the south Denver s location near the line where plains and mountains meet gives it many natural advantages These have made it the largest city between Kansas City and San Francisco

Gold was discovered here in 1858 and ever since Denver has owed much of its early prosperity to the wealth of mineral deposits in the nearby mountain valleys Later as irrigated farms and orchards were developed around it the city became an outstanding center of trade transportation and manufacturing

Today Denver is the great livestock market of the Rocky Mountain region It has large meat-packing houses sugar beet factories canning plants and flour and feed mills Its other manufactures include iron and steel goods refined petroleum and clay products It also has four huge railroad car shops

In 1934 through service was established between Chicago and San Francisco by way of Denver Trains leaving the city pass through the Moffat Tunnel and run over the Dotsero Cutoff on their way to the west coast (*see* Colorado) The tunnel s pioneer bore is now used as an aqueduct by Denver

The Mile High City

A tablet on one of the steps of the State Capitol indicates that at that point it is one mile above sea level Because of its altitude clear air sunshine and mountain scenery Denver attracts many tourists and health seekers It is a fine residential community with many lovely homes on wide boulevards Denver has many splendid parks within its limits Outside the city in the mountains are city-owned public recreational areas reached by good highways

The State Capitol s golden dome overlooks the civic center with its public library and open-air Greek theater The city has a United States mint and many federal agency field offices including the Reclamation Bureau Here too are the University of Denver the Colorado Woman s College Regis College and the state university s medical school

Early History

The first permanent settlements on Denver s site were established in 1858 During July of that year W Green Russell and his small party from Georgia had discovered gold dust in Dry Creek now in Denver News of this event started the first gold rush to the Pikes Peak region several months later

In October 1858 the Russell party founded the town of Auraria on the west side of Cherry Creek near its mouth on the South Platte River A rival group set up St Charles on the east bank It was soon renamed Denver for Gen James W Denver governor of the territory (At the time Colorado was in Kansas Territory) In 1860 the settlements merged and in 1861 Denver was chartered Population (1950 census) 415 786

DESERTS When a land is so dry that much more water evaporates than falls as rain during an average year the region is called a desert Deserts have also been defined as places without enough vegetation to support a human population Deserts are not absolutely rainless There probably is no spot on the globe without some rainfall

Most desert areas get less than five inches of rain in a year The rainfall is not only scanty but uncertain Years may pass between showers Records at Iquique in northern Chile showed no rain for a period of four years The fifth year brought 0 6 inches, making a five year average of 0 12 inches At another time 2 5 inches fell in a single shower Rain usually falls in violent downpours sometimes accompanied by hail They may last several days In these sudden torrential rains water sweeps down on the land carrying away rocks and soil tearing out roads bridges railways irrigation systems buildings and crops

Wide Temperature Spread

Temperatures vary widely in deserts The highest are in deserts in the low latitudes in or near the tropics Temperatures of well over 100° F occur regularly in summer Azizia 25 miles southwest of Tripoli holds the record with 136 4° F while Death Valley Calif comes close with 134°

Winters are cold in middle latitude deserts located far from the equator At Luktchin in central Asia the average temperature in July is 90° F while the January average is 13°—a range of 77 degrees

The temperature drops sharply in the desert night Dry air cloudless skies and bare dry earth furnish ideal conditions for the cooling of air after sunset A 24-hour range of 25 to 45 degrees is common and it may be as great as 60 or 70 degrees

Deserts are windy places Travelers constantly struggle against wind and sand The air is often dark with a fine dust that fills the eyes nose and throat Cloudiness is rare and the sunlight reflected from the bare earth is blinding

Relative humidity is low on the desert The hot dry air evaporates moisture rapidly In the Sonoran Desert a year s possible evaporation amounts to 100 inches This is about 20 times the amount of water that falls as rain Additional moisture is brought from under the ground by capillarity

Land Forms of Desert Regions

Desert areas vary greatly in appearance and in the nature of their surface features Only a small part of the earth s arid land consists of the vast expanses of billowing sand commonly thought of as typical desert (*see* Sand) Sand deserts are called *ergs*

The more common type of desert consists of rugged forbidding mountains separated by basins called *bolsons* The mountains receive most of the rain in *downpours* As the water rushes down the steep slopes it cuts deep gullies and carries a load of rock fragments gravel and sand to the bolson These materials are deposited as alluvial fans Sometimes the flood waters make a shallow lake in the basin Usually such lakes are temporary lakes called *playas*

MAJOR DESERTS OF THE WORLD

North Africa-Asia
1. Sahara
2. Libyan
3 Somaliland
4. Arabia
5. Kara Kum and Kizil Kum
6. Iran
7 Thar
8. Takla Makan
9. Gobi

South Africa
1. Namib
2. Kalahari

Australia
1. Great Sandy Desert
2. Great Victoria Desert

North America
1. Great Basin
2. Mojave
3. Lower California
4. Colorado Plateau
5. Sonoran
6. Mexican Plateau

South America
1. Peruvian Desert
2. Atacama
3. Western Argentina, including Patagonia

Here we see that the principal deserts lie in the low latitudes. They spread a few degrees north and south of the tropics and stretch inland from the west coasts of continents. Deserts in the middle latitudes are found where mountain barriers have robbed the winds of moisture. The map in the Grasslands article shows that semiarid steppes and savannas often border the deserts.

They lack an outlet, and when the water evaporates the bed is covered with white salt. Great Salt Lake is a permanent lake of this type.

Other deserts consist of rocky plateaus, called *hammadas*, separated by sand-filled basins, or ergs. Here differences in altitude are usually slight. Many hammadas are broad, flattish, dome-shaped areas. Where streams or wind wear away the weaker rocks, strong rock formations stand out boldly as *mesas* or *cuestas* (*see* Earth, subhead "Erosion in Dry Climates"). Pinnacles, needles, and arches carved in colored rocks lend fantastic beauty to the deserts of the American Southwest. Gullies are cut deep into the hammadas by the torrents. They are known as *wadies* in Arabia and *arroyos* in the Southwest.

Water and Drainage in the Desert

People can live and grow crops in the desert only at places where they can get water, called *oases*. In some spots ordinary shallow wells will reach the water table, but usually ground water lies at greater depths in deserts than in humid lands. In alluvial fans the water sinks deep into the porous material, but it may be reached by a well at the tip of the fan. In the wadies, ordinary wells can usually tap a supply of good water. Oasis settlements therefore are most often found where wadies are numerous. Ergs into which many wadies drain may have a water supply. Desert shrubs in the hollows between the dunes signal its presence. Deep artesian wells may be bored where the rock structure holds water under pressure (*see* Artesian Well). Some oases have a natural water supply where an artesian spring flows through a crack in the rock.

Streams that rise in rainy regions outside deserts bring the most generous supply of water for irrigation. All the large deserts except those of Australia are crossed by these *exotic* rivers. The largest and best known of them are the Nile in Egypt, the Tigris and Euphrates in Iraq, the Indus in Pakistan, and the Colorado in the United States. (*See also* articles on these countries and rivers.)

Desert soils are usually productive when given water. They are coarse textured and highly mineralized. Most widely cultivated are the water-transported soils of flood plains and alluvial fans (*see* Soil).

Plants and Animals of Arid Lands

Few parts of the desert are entirely barren. Where water seeps toward the surface, a great variety of plants spring up. After a rain low shrubs and grasses come to life, lending a greenish hue to the landscape. At blooming time, the plants are fragrant and bright with color. They grow quite far apart, instead of providing complete ground cover.

Desert plants differ in the ways they adapt themselves to arid places. Those which depend on the rain, sprout when it falls, bloom quickly, ripen their seed in a few days, then wither. Others depend upon underground water and have long root systems. These are succulent plants, such as the American cacti, which are able to store water. (*See also* Plant Life, subhead "Meeting Special Problems"; Cactus; Mesquite; Sagebrush.)

Animals live in all but the most barren stretches. The camel is the most useful domestic animal in desert regions because its structure permits it to travel far without water (*see* Camel). Various wild mammals, birds, and reptiles of arid regions get all their moisture from their food (*see* Animals, subhead "Securing and Saving Water").

World Distribution of Deserts

Most of the earth's deserts are strung along the Tropic of Cancer and the Tropic of Capricorn between

20° and 35° in both north and south latitudes These low latitude deserts lie mainly on the west coasts of continents though the North Africa Asia deserts extend across Africa and far into Asia Deserts inside continents extend poleward and are sometimes called middle latitude deserts Usually interior deserts are dry because mountain ranges have taken the moisture from ocean winds Europe is the only continent without a large desert area

The low latitude deserts lie mainly in the path of the northeast and southeast trade winds or in the adjacent horse latitudes (*see* Winds) The air is descending (subsiding) and the weather tends to be warm and dry with few clouds and variable winds When winds blow from the cold ocean to these warm lands the air is heated It drops little rain since moist air must be cooled to bring rainfall (*See also* Climate Rainfall articles on the continents)

Ice cap and tundra regions around the poles are sometimes called cold deserts They have little precipitation—usually less than ten inches Otherwise their climates have little in common with those of low and middle latitude deserts Their lack or scantiness of vegetation is chiefly due to cold

Land Use and Livelihood

Desert regions make up roughly 20 per cent of the earth s land area Their population is estimated at some 85 mill on or less than eight to the square mile Vast areas are uninhabited The only densely settled spots are irrigated places like the lower Nile River valley (*See* World population precipitation and vegetation maps)

Land is precious in oases so it is intensively cultivated In North Africa and Asia oasis farmers have commonly raised crops for their own use The chief food crops are dates figs wheat barley rice and beans Today they also raise such commercial crops as cotton and sugar cane In the United States irrigated lands are mainly used for commercial crops —citrus fruits dates winter vegetables and cotton

In the arid lands of Africa and Asia nomadic folk make a livelihood by grazing stock Usually they stay close to the rim of the desert where seasonal rains fall or on the dry *steppe* nearby They must move constantly to find grass They trade in the oases (*See* Nomads Grasslands Sahara Arabia)

Desert life is changing Irrigated lands are being greatly extended by giant river control systems (*see* Irrigation Dams) Oases once reached only by slow camel caravan now have airports and service stations for automobiles buses and trucks Settlements have sprung up in deserts to obtain mineral riches such as the petroleum of Saudi Arabia Iraq and Iran and the copper and other metals of arid North and South America Typical desert minerals are soluble salts deposited by the high evaporation *Sodium nitrate* the most valuable of them comes from the north Chile desert (*see* Chile) Future changes will depend in large part on political control extension of trade and the extent of the people s advancement in technology science and education

Des Moines (*dē moin*) Iowa Its central location in Iowa makes Des Moines the heart of the nation s richest agricultural area It is Iowa s largest city and an important center of trade transportation and manufacturing It has been the state capital since 1857

Iowa farms supply hogs cattle and poultry to the meat-packing plants in Des Moines milk to its creameries and ice cream makers and corn and wheat to its flour and feed mills The city produces farm equipment and implements rubber tires milking and other machinery aircraft parts wearing apparel and cement Coal from bituminous fields nearby provides fuel for industries and homes Des Moines is the chief farm publication center of the United States The main offices of 50 insurance companies are located here and the city is often called the Hartford of the West

Points of interest include the State Capitol with its gilded dome the Iowa State Department of History and Archives with a fine library and museum and the Des Moines Art Center with an art museum and study center The city has a civic center with beautiful public buildings and several public parks

Des Moines has an outstanding public school system which emphasizes work with handicapped children and adult education It is the seat of Drake University Grandview (junior) College and Des Moines Still College of Osteopathy and Surgery

The city grew up around Fort Des Moines built in 1843 at the junction of the Raccoon and Des Moines rivers It was chartered as a city in 1856 In 1907 it adopted a commission form of government known as the Des Moines Plan but in 1950 it voted for city manager rule Eight railroads four federal highways and three airlines serve Des Moines Population (1950 census) 177 965

De Soto Hernando (1500?–1542) One of the most famous gold seekers in history was the Spaniard Hernando De Soto He spent three years wandering from Florida to Oklahoma in his search He discovered the Mississippi River and died alongside it He found no gold but his explorations gave Spain a claim to a vast area

De Soto was born about 1500 in Barcarroto Spain Like most Spanish boys of good family he dreamed of fortune in the New World His chance came when a family friend Pedrarias Dávila was appointed governor of Darien (now Panama) When De Soto was about 19 he sailed to serve under Dávila He became a ruthless and daring soldier Men feared his temper and admired his skill as a horseman

In 1524 De Soto was made a captain in an expedition to Nicaragua Four years later he led his own expedition along the east coasts of Guatemala and Yucatán In 1532 he joined Pizarro in the conquest of Peru (*see* Pizarro) De Soto s share of the Peruvian treasures made him rich He returned to Spain and married Dávila s daughter Isabel

The Spaniards did not know the country north of Florida Captive Indians told stories of lands

there richer than Mexico or Peru. De Soto decided to win another fortune from this region. He persuaded the king of Spain to appoint him governor of Cuba and Florida. He recruited a thousand men and helped pay for their equipment. This great army set sail from Spain in April 1538. At Havana, Cuba, they set up an advance base and made final preparations.

On May 30, 1539, De Soto and his men went ashore at Tampa Bay in Florida and struck inland. They were a proud company in flashing armor, their bright banners streaming in the sun. They marched north to Georgia, then turned west and followed the Alabama River to Mobile Bay. But they were ill-equipped for a long journey. Their supplies ran low and their arms became battered and rusty. De Soto rallied his men with the prospect of riches ahead.

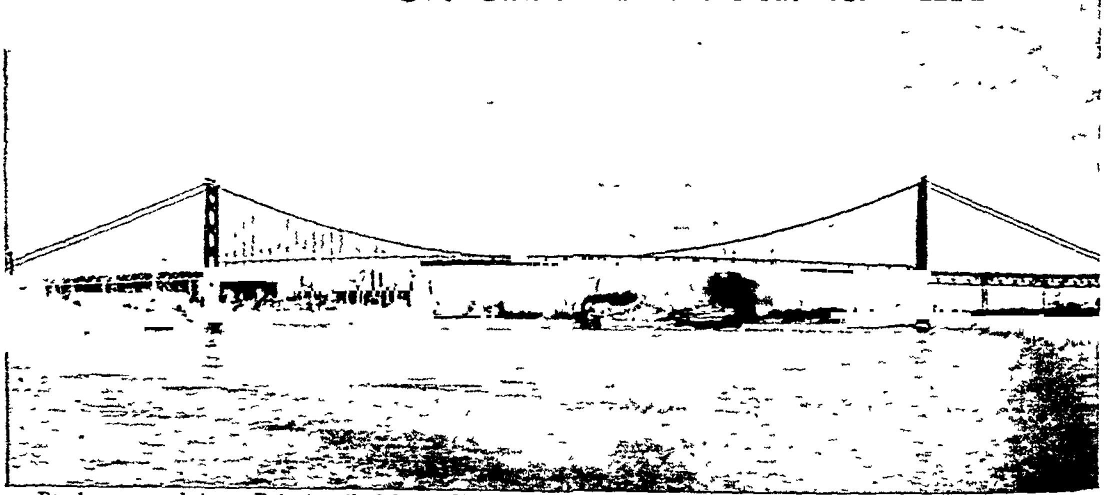
Along the way they met many Indian tribes. De Soto forced the Indians to furnish supplies and tortured their chiefs in a useless effort to make them tell where gold was hidden. This brutality led to many battles. The bloodiest was fought near Mobile Bay. About 70 Spaniards were killed and many more were hurt. De Soto himself was severely wounded.

De Soto first saw the wide rush of the Mississippi near the present site of Memphis in the spring of 1541. The men built boats and crossed the river. By the next autumn they reached the Neosho River in northeast Oklahoma before they turned east again.

Everywhere De Soto searched, the Indians reported gold "just ahead" in order to escape his torture. But after three years, he still had found no gold. In the spring of 1542 De Soto led his worn and tattered men south. Near the junction of the Red and the Mississippi rivers. De Soto fell ill and died.

He was first buried by Indian slaves. But his men feared the Indians would take revenge on the body. They secretly recovered it and placed it in a hollowed oak log. They weighted it with De Soto's armor and in the night sank it in the Mississippi. The remaining men built small ships and floated down-river to the Gulf of Mexico. They finally reached a Spanish settlement on the east coast of Mexico.

The BUSY "MOTOR CITY" *Between the* LAKES



People may pass between Detroit, at the left, and Windsor, Canada, either under or over the Detroit River—that is, by tunnel or by the huge Ambassador Bridge shown here. This view looks northeast, with the heart of Detroit beyond the bridge at the left.

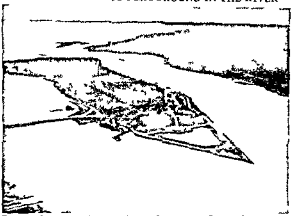
DETROIT, MICH. The fame of Michigan's chief city has reached the far corners of the earth along with automobiles from its great factories. Few people in the civilized world today have not heard the name Detroit. This metropolis makes close to three-fifths of the world's automobiles, and automobiles have made Detroit a metropolis.

In 1900 the city of Detroit had a population of only 285,704. But during the next 20 years a thriving automobile industry had attracted so many people that the population of the city more than tripled. Of the 650,000 workers who have come from every land to this mecca of skilled labor and high wages, about 385,000 work in the motor industry. Thousands more make steel, tires, paints, upholstery, and other products used by the automobile makers. Automobile profits, wages, and salaries have paid for most of the fast-moving cars that throng the wide boulevards circling and crossing the city's 140 square miles. Wealth from the automobile industry is the main support of the city's cultural, educational, charitable, and social institutions.

Several pioneer builders of automobiles—including Henry Ford—lived and worked in Detroit before they

began to make automobiles The city proved an excellent site for industrial development Its location on the Detroit River with access to Lake Huron and Lake Erie makes it an ideal spot for assembling raw materials for manufacturing Down Lake Huron come ore barges from Lake Superior s iron ranges passing boats loaded with lumber from Michigan s deep woods and ships full of foodstuffs from the middle western states At *Detroit s 11 mile* water front they meet long barges of Pennsylvania coal shipped from Lake Erie ports The 25-mile Detroit River carries more tonnage than any other river in the world several times that of busy Suez Canal A vessel every three minutes is the average during the navigation season Many railways truck lines and airways add their share to the endless traffic

DETROIT S FAMOUS PLAYGROUND IN THE RIVER



This airplane view shows Belle Isle Park in the Detroit River with Lake St Clair and the Canadian shore in the background The island is reached by the bridge at the left and offers among many other attractions a zoo an aquarium and excellent boating.

French fur traders and missionaries first recognized the rich destiny of this site Antoine de la Mothe Cadillac soldier of fortune under Louis XIV built Fort Pontchartrain here in 1701 and settled it with 50 soldiers and 50 colonists England spreading its power across the continent eyed this stout fort greedily and conquered it in 1760 From this base the British sent their Indian allies on bloody raids into the Ohio country during the Revolutionary War The new born United States was awarded this spot as part of the Northwest Territory by the treaty of Paris but the British did not release it until 1796

The little military and trading post called Detroit from the French word for strait (*détroit*) became the capital of the newly formed Michigan Territory in 1805 It again fell to the British during the War of 1812 but the battle of Lake Erie returned it to the United States a year later

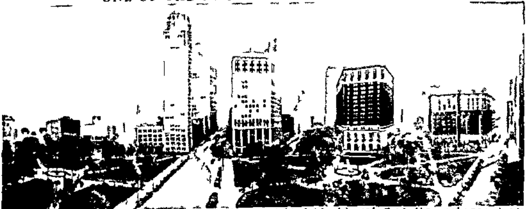
A fire in 1805 burned every house but one Judge Augustus Woodward laid out a plan for the new town based on L Enfant s plan of Washington D C Wide streets radiated in a half wheel from a point close to the river The general center is marked today by the Campus Martius and Cadillac Square These streets moved past small parks and residential districts then close to the center of the town Grand Boulevard formed the boundary of the original city plan

Population Doubled Every Ten Years

But the population of Detroit more than doubled every ten years between 1830 and 1860 and after 1860 it grew steadily The city spread far beyond Grand Boulevard A gridiron street system was superimposed upon the original half wheel The radial thoroughfares from Fort Street to Jefferson Avenue now cut across Grand Boulevard and lead to handsome suburbs in the outskirts Around the city lie several express highways beginning with Seven Mile Road and ending with Twelve Mile Road

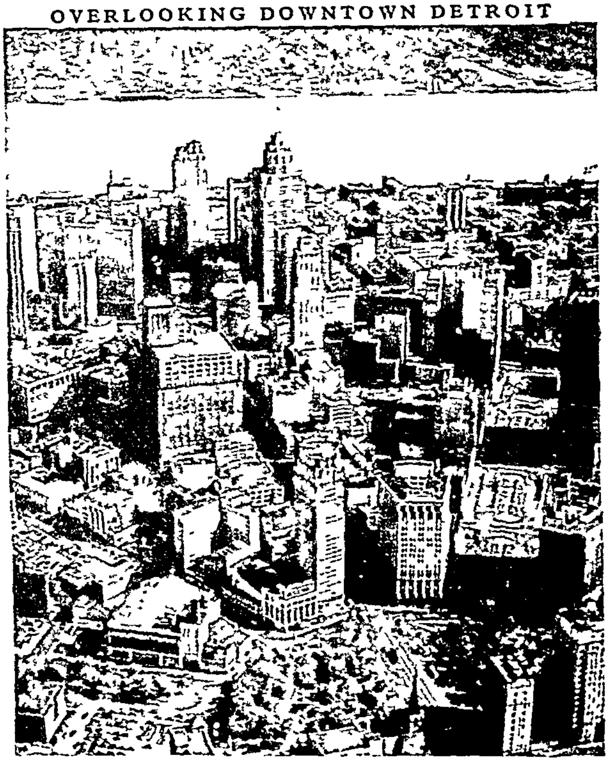
River Rouge Park is the largest of the scores of parks in Detroit s recreation system In the great zoo

ONE OF THE TWO HEARTS OF DETROIT



Here we look from north to south across Grand Circus Park encircled by hotels, clubs and office buildings and giving origin to streets running in every direction. Further south along Woodward Avenue (left center) is the heart of the business district

OVERLOOKING DOWNTOWN DETROIT



This airplane view of Detroit's business district looks south across the Detroit River to Windsor, Ont. In the center, Woodward Avenue, the city's busiest thoroughfare, crosses Grand Circus Park.

far out on Woodward Avenue, each animal lives in surroundings similar to its native home.

Culture goes hand in hand with recreation in Detroit. An art center has grown up around the Institute of Arts and the beautiful public library, designed by Cass Gilbert. Art center buildings include the Children's Museum and the Detroit Historical Museum. Detroit's symphony orchestra is among the country's finest. Operatic and theatrical companies visit the city regularly.

The city's progressive and thorough school system does not stop with high schools and junior colleges, but also includes Wayne University. Night schools aid in the Americanization of the men and women from 40 nations who have flocked to this great center of industry. Other outstanding educational centers are the University of Detroit in the city and the Cranbrook institutions at Bloomfield Hills, 20 miles to the north. The waterworks and street railway and bus lines are owned by the city. Detroit also produces its own electricity for municipal use.

Vast Wealth from Factories

The automotive industry was primarily responsible for Detroit's rapid expansion. But the city's convenient location and abundant labor supply soon attracted hundreds of other manufacturing industries. Iron and steel works were among the first to be established, and the tremendous demands of the automotive industry soon made Detroit a leading steel producer. The city also ranks high in the manufacture of stoves, pharmaceuticals, electric appliances, adding machines, and salt products.

During the second World War Detroit's automotive industry converted to make planes, tanks, and other munitions. By 1947 the value added to products by the city's manufacturing industries was about 3 billion dollars a year, or almost three times its 1939 output.

The population of Detroit itself does not include more than one million suburban dwellers. Hamtramck and Highland Park are independent cities entirely surrounded by Detroit. Other large suburbs include Dearborn, Royal Oak, Wyandotte, and Ferndale. Many other Detroit workers live in Canadian border cities, crossing to Detroit by the Ambassador Bridge or through the vehicular tunnel beneath the Detroit River. Population (1950 census), 1,849,568.

DEUCALION (*dū-kā'lĭ-ŏn*). According to Greek myth, when Zeus destroyed the human race by a flood, only Deucalion, son of Prometheus, and his wife Pyrrha were saved. Deucalion built an ark in which he and Pyrrha floated during the nine days' flood. When the waters receded, the ark rested on Mount Parnassus. The oracle told Deucalion and Pyrrha to repeople the world by throwing behind them the "bones of their mother." Interpreting this to mean the stones of mother earth, Deucalion threw stones which turned into men; those thrown by Pyrrha turned into women.

DE VALERA, EAMON (born 1882). Quiet, scholarly Eamon De Valera was one of Ireland's greatest fighters in its struggle for independence. He led his country from 1932 to 1948, first as president of the executive council and later as prime minister. He again became premier in 1951 (*see* Ireland).

De Valera was born in New York City on Oct. 14, 1882. His father was Spanish and his mother Irish. When the boy was two his father died, and Eamon went to live with his grandmother in County Limerick, Ireland. He was reared a Roman Catholic. In school he was a brilliant student and a good athlete, especially in track. At 16, he won a scholarship to Blackrock College near Dublin. In 1904 he took his degree in mathematics at Royal University, now the National University of Ireland.

For years De Valera gave little thought to politics. He taught languages and mathematics at several schools. He also joined the Gaelic League, which aimed to revive Irish culture and the ancient Gaelic language. In 1910 he married Jane O'Flanagan, a teacher of Gaelic. They had six children.

In 1913 he joined the Volunteers, an underground army pledged to fight British rule. During the Easter Week rebellion in 1916 he led a group of 50. All leaders were executed except De Valera. He was sentenced to life imprisonment. In jail he calmly studied mathematics and read widely. But in 1917 the British released all political prisoners. De Valera was at

once elected to the Irish parliament and rose to leadership in the Sinn Fein

Again jailed for revolutionary activity, he escaped to America and raised money for the Irish cause The Anglo-Irish treaty of 1921 was far short of De Valera's ideal of an independent Ireland He refused to accept it His republican group fought the Free State government and in 1923 De Valera was imprisoned for a year

EAMON DE VALERA

Born in America De Valera led Ireland a fight for freedom

The Sinn Fein returned him to parliament in 1924, but the party split on taking the oath of allegiance to the king In 1926 he formed a new party, Fianna Fail (Soldiers of Destiny) It won control in 1932 and he became president of the executive council

In 1933 and in 1938-39 he was president of the League of Nations Assembly In 1938 De Valera became prime minister He strongly opposed giving aid in World War II and kept Ireland neutral The Allies and many in his own country criticized his decision but he held office till 1948 and regained it in 1951 In 1954 however his austerity non-Socialist program lost him re-election.

Dew. The warmer the air is, the more moisture it can hold Through the day streams, plants and trees give moisture to the air by evaporation When night comes the earth loses some of its heat through radiation its surface feels cool and clammy to the touch The layer of air just above the earth loses its heat too, and soon reaches a point at which it can hold no more moisture (*saturation point* or *dew point*) The water is squeezed out of the air as it cools and forms in little globes on any solid object In the same way warm air deposits its moisture on the surface of a pitcher of ice water

Dew does not form readily on cloudy or windy nights The clouds act as a kind of blanket to prevent the earth from radiating heat into space, and the wind mixes warm air with the cool air near the surface Thus the surface air cools more slowly and does not reach the dew point Abundant dews form in valleys where the heavier cooling air settles at nightfall, also in areas of dense vegetation where the ground is usually moist and the circulation of air is sluggish But even under the most favorable conditions, there is rarely more than one inch of dew a year (*See also* Evaporation, Water)

Dewey, Admiral George (1837-1917) On the night of April 30, 1898, six United States war vessels commanded by Commodore George Dewey moved boldly into Manila Bay in the Philippine Islands Dewey had been ordered to "capture or destroy" the Spanish fleet in Philippine waters Backed by powerful ships and expert gunners, Dewey sailed into a fight that was to make naval history

Born in Montpelier, Vt Dec 26 1837, he was graduated from the Naval Academy at Annapolis in 1858 During the Civil War he served under Farragut in the battle of New Orleans After the war he rose through the ranks of lieutenant commander, commander, and captain Finally as commodore he was placed in command of the Asiatic squadron

When war between the United States and Spain was declared in 1898 Dewey's squadron was off Hong Kong, China Ordered to attack the Spanish at Manila, Dewey pushed his vessels there at full speed In the early dawn of May 1, the American warships, steaming in column formation, bore down on the Spanish ships drawn up in front of Cavite Point Within a few hours Dewey completely destroyed the enemy ships, silenced the Spanish land batteries and captured the Philippines' chief port—all without the loss of a ship or of a man

As soon as the news of this victory reached America, President McKinley appointed Dewey a rear admiral Before his return to the United States in 1899 he had been made admiral, a rank conferred before only upon Farragut and Porter Congress voted that Dewey should never be placed on the retired list of the navy, he was still considered in active service at the time of his death (Jan 16, 1917), although he was then 80 years old A house in Washington was purchased for Admiral Dewey by popular subscription

Dextrin The sticky film on postage stamps is dextrin, a sweetish substance halfway between starch and sugar Dextrin is made by roasting dry starch and then quickly cooling it If the process is not stopped in time, a sugar, *dextrose*, is produced instead (*see* Glucose) When bread is toasted, much of the starch is changed into dextrin, an easily digested food Baked potatoes and bread crusts are also easily digested because they contain much dextrin

About half the dextrin produced commercially is used with starch as a sizing in the textile industry The rest is used as an adhesive Dextrin can be dissolved in cold water, applied to paper, and dried When remoistened it becomes sticky again This makes it particularly useful for postage stamps, envelope flaps labels, and other gummed paper

Dextrin can be made from any starch—corn, potato tapioca sago, or sweet potato But each kind differs slightly from the others For stamps and envelopes the Bureau of Engraving and Printing uses tapioca dextrin because it is less likely to be washed off entirely when the stamp or envelope flap is moistened Sweet-potato dextrin has similar properties Potato dextrin is used to make white library paste Cheaper cornstarch dextrin is most commonly used in fashioning paper bags and boxes

In making dextrin dilute sulphuric acid is sometimes added to the starch Dextrin produced by this method is a whitish powder Starch roasted without an acid produces a brownish dextrin, called "British gum" or "burnt starch "

The DIAMOND—*Most* VALUABLE *of* GEMS

DIAMOND. The diamond is the hardest of all substances. Its English name comes from the Greek word *adamas*, meaning "unconquerable." Its brilliance and fire make it a favorite gem of royalty and common people alike; its hardness makes it a valuable cutting aid for industry.

Diamonds are crystals of pure carbon, the same chemical material as coal and graphite. The General Electric Company displayed in 1955 about 100 small man-made diamonds produced in its research laboratories. These stones met the same tests as natural diamonds. They were made by subjecting graphite to tremendous heat and pressure. A similar process deep inside the earth is believed to have caused the formation of natural diamonds. (*See* Carbon; Crystals.)

Weights of both gem and industrial diamonds are now expressed in *metric carats*, one carat equaling one fifth of a gram. Formerly the weight of a carat varied slightly from country to country.

Qualities of a Gem Diamond

The brilliance and fire of a gem diamond result from its properties of *refraction*, *reflection*, and *dispersion*. Upon entering a diamond *facet* (one of many small planes cut onto the gem surface) a light ray is refracted, or bent. The bent ray is reflected from a bottom facet up through a top facet. In refraction, each color of the ray is bent at a slightly different angle; this spreading out of colors is called dispersion. Since refraction occurs both as the ray enters and leaves the diamond, dispersion also occurs twice. Thus the ray is emitted as a glittering rainbow. Of all gems the diamond has the highest property, or index, of refraction, 2.419. (*See also* Color; Lens; Light.)

Most diamonds are tinged with color. If a diamond's color is sufficiently intense, it is prized as a gem and called a "fancy." Blue and pink diamonds are the most valuable. One that is red is unique. Green color arouses suspicion, as diamonds have been colored green in a cyclotron (*see* Atoms, subhead "Cyclotron and Betatron"). Another prized diamond is one that has the white lucidity of clear spring water.

Cutting and Polishing the Gem Diamond

Generally, diamonds when found or mined have a crystalline shape. Two or more gem stones are usually cut from a rough stone. The diamond cutter's trade is highly skilled. His task is to place the facets so that the most light rays will reflect through the top facets.

Diamonds are first split or sawed along the grain of the diamond. The gem pieces are then mounted in a lathe. The fast-turning stone is shaped roughly by a diamond-pointed tool. Next, the rough is placed in solder in a *dop* (holder) and a facet ground on the surface by a spinning iron disk bearing a paste of diamond dust and olive oil. The cutting of each facet requires changing the position of the stone in the dop. For holding the larger diamonds dops are equipped with mechanical holding fingers.

Diamond gems have been cut in many different shapes. Some of these can be seen in the accompanying pictures of famous diamonds. The *brilliant* cut is the most popular. This has 58 facets, 33 above the girdle (circle at greatest diameter) and 25 below. (For diagrams of the cuts, *see* Jewelry and Gems).

Antwerp and Amsterdam are the traditional centers of the diamond-cutting industry. Since the beginning of the second World War New York City has also become an important cutting center.

How Industry Uses Diamonds

In even the best gem-producing areas only about 25 per cent of the diamonds mined are of gem quality. The rest, of poor gem quality because of color or faults, are used in industry. An old saying, "it takes a diamond to cut a diamond," is true: diamonds are used by the lapidary (gem cutter) to shape and polish diamonds and other gems.

Diamonds are used to true the surfaces of precision grinding wheels. In machine shops, tools tipped with diamonds cut grooves around automobile pistons and perform other precision-cutting tasks. Needles tipped with diamond dust drill holes through some diamonds. A new process does this electrically. Diamonds with holes are used as feeder nozzles for oil furnaces and as wire-drawing dies. Some 400 tons of copper can be drawn through a diamond die into a wire fine enough to circle the world 20 times before the die shows signs of wear (*see* Wire). Geologists and engineers use diamond-tipped hollow steel bits for drilling into the earth to secure samples of deep-lying rock formations (*see* Mines and Mining). Saws tipped with hundreds of diamonds eat through granite stones as easily and quickly as a steel saw cuts through a wooden plank. For centuries diamond-tipped tools have been used to cut glass.

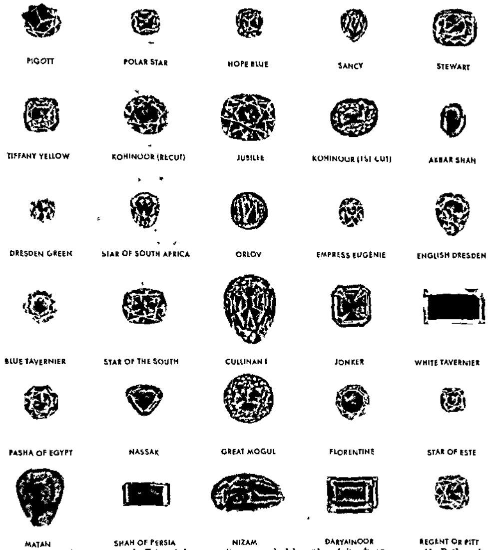
Where Diamonds Come From

Diamonds have been found on all continents. For hundreds of years the diamond mines of India were the chief source of diamonds. Some of the most famous gems came from Indian mines. Troops of Alexander the Great, returning from an invasion of India in 327 B.C., probably brought the first diamonds to Europe.

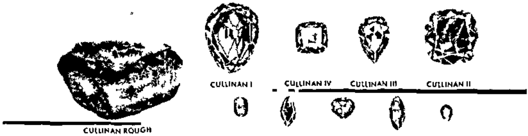
About A.D. 600, diamonds were found in Borneo, and the Indonesians still mine some there. Brazil's rich fields were discovered in the 1700's. The even richer fields of South Africa were opened in the middle 1800's (*see* South Africa, Union of). In Africa now diamonds are mined in Tanganyika, the Belgian Congo, Angola, Sierra Leone, Gold Coast, French West Africa, French Equatorial Africa.

The Belgian Congo leads the world in total weight of diamonds mined, but these stones are generally poor and are mostly used in industry. The diamonds mined in the Union of South Africa, amounting to little more than one fifth of the weight of Congo production, are far more valuable because about 25 per cent of them are of gem quality.

FAMOUS DIAMONDS OF THE WORLD



These are replicas of famous diamonds Tales of slaves, royalty, theft, and murder are told about the real gems Some, like the Great Mogul, have disappeared The Pigott was reported smashed by order of its dying owner, Ali Pasha, vizier of Albania The Matan, a Borneo stone, has never been examined by an expert It may be a crystal and not a diamond at all.



These are glass replicas of the Cullinan rough largest diamond ever found, and the nine largest gems cut from it The originals are among the English crown jewels The four largest are I, a pendeloque cut, set in the scepter, IV, a square, III, a pendeloque, and II a square brilliant The bottom row cuts are emerald, marquise, heart shape, marquise, and pendeloque.

The United States produces few diamonds. Pike County, Ark., has furnished most of them, including one of 40 carats. Diamonds have been found in California, North Carolina, Virginia, Ohio, Wisconsin, and Indiana.

Diamond Mining

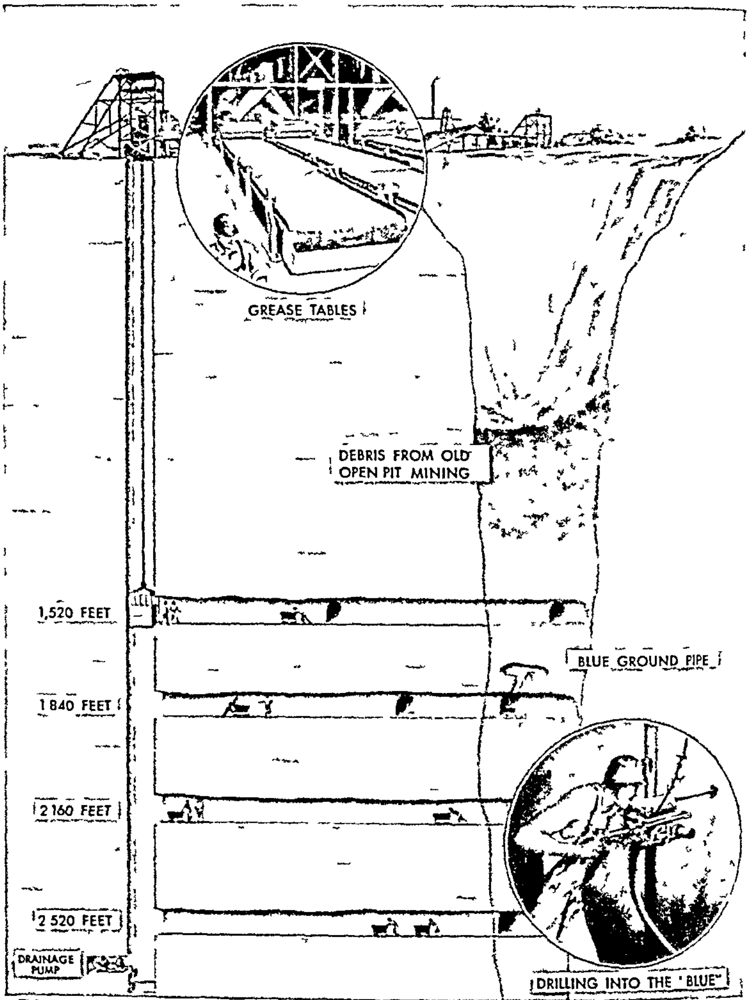
Diamonds were probably formed millions of years ago in molten lava. The geologic faults or vents through which the lava flowed to the surface are called *pipes*. After volcanic activity ceased, the lava cooled and solidified into a blue rock called *kimberlite*.

In mining kimberlite, shafts are sunk some distance from the pipe. Horizontal tunnels then are driven from shaft to pipe. The kimberlite is taken above ground for processing. The shaft of the Kimberley mine in South Africa is more than 3,500 feet deep. Pipe mines are found in the Union of South Africa and Tanganyika. Arkansas diamonds are also taken from a pipe.

In other parts of Africa and the rest of the world diamonds are found in alluvial soils. It is believed the diamonds were washed to these fields from areas of diamond-bearing kimberlite. South Africa's pipe mines are in an eroded mountainous region. Over some millions of years the heights reared by volcanic action, have been washed away by rain-filled streams.

Diamonds are not plentiful, even in kimberlite. It has been estimated that more than 2,000 tons of kimberlite must be processed in order to secure as much as a small handful of diamonds.

A SOUTH AFRICAN DIAMOND MINE



Diamond-bearing rock, called "blue ground," or "kimberlite," is found in the vents or "pipes" of some old volcanoes. Mine shafts are drilled parallel to the pipe. Tunnels are driven from shaft to pipe. The blue ground is loosened by dynamite blasts. Hoisted to the surface, the blue ground is crushed and some wastes eliminated. The remaining "concentrate" and water are worked over grease tables. Diamonds stick to the grease and the wastes are washed away.

Famous Old Diamonds

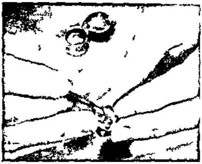
The Kohinoor is probably the best known of all diamond gems. There is a tradition that it was taken in 1304 from a rajah at Malwa, whose family had held it for centuries. It is believed to have been guarded with other treasures at Delhi until 1739, when it was carried off by Nadir Shah of Persia. After further adventures it was surrendered to the East India Company, whose directors presented it to Queen Victoria. Its weight was 186 carats. Queen Victoria had it recut in 1852, and the gem now weighs 106 carats. It is among the English crown jewels.

The Great Mogul was the largest Indian diamond known. The rough stone weighed 817 carats. Inexpert cutting reduced it to 287½ carats. The French gem expert Tavernier examined it in Delhi in 1666. There has been no authentic news of the Great Mogul since his time. It may have been one of the gems taken by Nadir Shah.

The Orlov, now part of the Soviet diamond treasury, was one of the Russian crown jewels. Legend has it that it was one of the eyes of an idol in a Brahman temple. A French grenadier stole it and sold it to an English sea captain. After passing through several hands, it was sold by an Armenian merchant to Count Orlov, once a favorite of Catherine the Great. Orlov gave the gem to Catherine, hoping the fabulous gift would restore him to favor. It did not. The stone as cut weighs 199.6 carats.

The celebrated Regent or Pitt diamond, weighing 410 carats in the rough, was found in India in 1701. Legend says that a slave stole it and gave it to a

STEPS IN CUTTING AND POLISHING A DIAMOND



Above a rough diamond is marked for splitting or cleaving Another diamond then is used to cut a groove in the stone at the mark (not shown) In the center the cutter prepares to strike the blow that will split the stone At right a facet is being cut on a diamond by pressing it against an iron wheel coated with a paste of olive oil and diamond dust

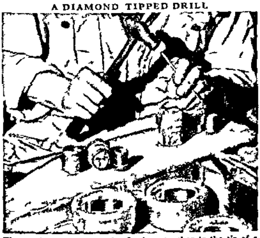
sea captain for a passage to freedom Once at sea however the captain threw the slave overboard The stone was purchased by Sir Thomas Pitt governor of Madras In London it was cut down to 143 2 carats In 1717 Pitt sold it to the French crown Later Napoleon had it set in his sword hilt After his fall it was placed in the Louvre

The Excelsior discovered in 1893 at Jagersfontein in the Orange Free State South Africa weighed 969½ carats From this single stone ten brilliants varying in weight from 13 to 68 carats were cut

Large Diamonds Found Since 1900

The largest diamond ever found was the Cullinan It was taken from the Premier mine Transvaal South Africa in 1905 It was as large as a man s fist and weighed 3 106 carats (1⅓ pounds) In 1907 the Transvaal government presented it to King Edward VII The next year it was cut into nine large and

A DIAMOND TIPPED DRILL



The mechanic is putting the finishing touches to the tip of a diamond drill Diamond drills bore deep into the ground for sample cores of underground rock. Such samples inform engineers and geologists of underlying structure

more than 90 small stones Edward desired the larger stones to be called Stars of Africa but they are also known as Cullinan I II III etc Cullinan I (530 carats) is set in the English scepter Cullinan II (309 carats) is in the English state crown

The Jacobus Jonker (726 carats) was named for the prospector who found it in Transvaal in 1934 In 1935 it was sold to a New York City dealer for more than $750 000 Twelve gems were cut from it The Vargas diamond (726 6 carats) was discovered in 1938 in the state of Minas Geraes Brazil It was named for Brazil s president of the time This blue-white stone was cut by a New York City gem cutter into 29 separate gems In 1945 a 770-carat diamond the fourth largest ever found and the largest ever taken from alluvial deposits was dug up from along side the Woyie River in Sierra Leone West Africa

DIANA A Roman divinity Diana was later identified with the Greek goddess Artemis She was represented as the twin sister of Apollo and was the moon goddess as Apollo was the sun god Many stories show her also as a chaste huntress (*See also* Artemis)

DIAPHRAGM (*dī ȧ frăm*) Next to the heart the diaphragm is perhaps the most important muscle in the body It is a dome-shaped membrane extending across the body below the chest cavity and separating the lungs and heart from the abdomen Its edge follows the general outlines of the lower ribs being fastened to the breastbone in front When the diaphragm straightens out and compresses downward it sucks air into the lungs It is thus the principal muscle of respiration The muscles between the ribs are also used as respiratory muscles (*see* Respiration)

Diaphragm breathing means using the diaphragm almost entirely leaving the upper ribs extended in a stationary position Singers and speakers use diaphragm breathing to obtain great volume and control of the voice For ordinary purposes both rib and diaphragm breathing should be cultivated Anything which restricts breathing such as tight clothing or lacing should be avoided

DIARY. A diary is a daily personal record. In it the writer is at liberty to record anything he chooses —events, comments, ideas, reading notes, or any variety of subjects in his mind as he sits down to make his entry for the day. People on vacation journeys often keep diaries, noting new sights, new friends, and new experiences. Reading one's own travel diary in later years helps recall the pleasures that may have slipped from memory.

In past centuries men in public life often kept diaries. These have become valuable sources of fact and interpretation for later historians. The private, candid observations set down in these personal journals often provide truer pictures of an age than do official records or books published (and often censored) during that time. For the most part, these important diaries of the past were never intended to be read by others. The diarists made entries simply as aids to memory or as a way of unburdening themselves of weighty matters. The diaries served as listeners who could keep secrets well.

In modern times, however, statesmen and other important people realize that their diaries will very likely be read in manuscript by historians or in published form by the public. Thus they make entries with these readers in mind, and many of their diaries lose the confidential, intimate nature of the older journals. On the other hand, they tend to make their entries more complete and self-explanatory.

The most famous diary in English was that kept by Samuel Pepys (1633–1703). Pepys, a civilian official of the British navy, made regular entries between 1660 and 1669. His diary starts at the beginning of the Restoration period in English history and pictures many of the court intrigues and scandals of his day (*see* Charles II, King of England; English History). The diary reveals Pepys as a man prone to many human weaknesses, but honest with himself. Pepys wrote his entries in a combined cipher and shorthand that was not solved until 150 years later.

Other famous English diaries were those of John Evelyn and Jonathan Swift (*see* Swift). The De Goncourt brothers, Jules and Edmond, kept a detailed journal of Parisian artistic and literary activities for several decades of the late 19th century.

Keeping a diary can be an enjoyable pursuit. Like a snapshot album, it holds one's personal history ready for a reminiscent review. For people who want to improve their skill in written composition, maintaining a diary is good discipline and practice. Blank diaries, ruled and dated, are sold in stationery stores, but any notebook will serve the purpose.

DIATOMS. The tiny one-celled plants called diatoms are found by the billions of billions in all the waters on the face of the earth. The largest of them are barely visible to the naked eye and the smallest are less than a thousandth of an inch long. Yet each of them builds for itself a stone shelter as hard as granite, adorned with intricate patterns. More than 10,000 species are known, with many shapes—circular, square, boat-shaped, stick-shaped, and triangular.

Greatly enlarged photographs of diatom shelters (called *frustules*) are shown in the article on Microscope. Each frustule consists of two shells or valves, one fitting over the other like the top and bottom of a box, and held together along the edges by a girdle. Inside lies the living plant, resembling its relatives, the brown algae, in color and structure (*see* Algae).

Most diatoms float helplessly in the water or fasten themselves with a sort of jelly to stones or larger water plants. A few are able to swim slowly from place to place, but how they propel themselves is not clearly understood.

Diatoms usually reproduce by splitting in two. The interior living cell divides, the valves separate, and each half grows a new valve on its exposed surface. At times, two diatoms unite after shedding their old valves entirely, then divide into two larger individuals again, each of which forms two new valves. Some species reproduce by means of spores. In a few days, a single diatom may multiply into several million.

In cold waters, where diatoms are most plentiful, the dead and the discarded shells may form thick deposits on the bottom. These shells, made of silica, the same mineral as quartz, are much harder and more durable than are the chalky shells of mollusks (*see* Silicon). Thus, after long ages, the shell deposits turn into a porous mineral mass called *diatomite* (also known as diatomaceous earth, tripolite, and kieselguhr), composed of about 50 million shells to the cubic inch. Deposits of diatomite are found on the sites of many ancient oceans and lakes, some of them several hundred feet thick. (*See also* Ocean.)

Diatomite is used as a chemical filter, particularly in the sugar industry, and in the preparation of heat-insulating materials and polishing compounds and for mixing with concrete.

DIAZ (*dē'ąsh*), **BARTHOLOMEW** (1450?–1500). The first European to see the stormy Cape of Good Hope at the southern tip of Africa was Bartholomew Diaz (or Dias), courageous Portuguese sea captain and explorer. Diaz was one of the great Portuguese captains who helped find the eastern sea route between western Europe and Asia.

As a youth Diaz entered the hazardous gold and ivory trade along the African Gold Coast and rose to the rank of captain. At this time the Italian cities were growing rich on their trade with India and the Far East. Portugal and other European nations were eager for a share of this trade, but the Italians controlled the Mediterranean, the chief trade route to the East (*see* Trade). The Portuguese dreamed of finding an all-water route around Africa, a dangerous voyage for the small ships of the time. The work had been well begun by Prince Henry, who had sent ships on ever-lengthening voyages down the African coast (*see* Henry the Navigator). Exploration continued under his nephew, King John II. When Diogo Cam (or Caõ) returned to Portugal with word that he had sailed past the mouth of the Congo River, John was encouraged to send another expedition to sail even

closer to the goal of the Far East He chose Diaz to lead the venture

With two caravels and a storeship Diaz left Lisbon in August 1487 He sailed straight from Cape Palmas to the mouth of the Congo then kept close to the coast until he reached Cabo da Volta (present-day Luderitz) About New Year s Day 1488 a gale hit his cockleshell ships and blew them southward past the southernmost tip of land After 13 days he managed to turn east but found no sheltering shore Turning north he sighted Mossel Bay beyond the Cape of Good Hope Unknowingly and out of sight of land he had rounded the cape

Almost at the entrance to the Indian Ocean Diaz crew, weary and afraid virtually forced him to turn back On the return voyage he charted the southern waters, and in May 1488 he saw the cliffs of the Cape of Good Hope for the first time (*see* Cape of Good Hope) Diaz called it Cabo Tormentoso— stormy cape"

Diaz was joyously welcomed home in December 1488 The task which he began was completed ten years later by Vasco da Gama who sailed around the Cape of Good Hope and on to India (*see* Gama) Diaz supervised the building of Da Gama s ships and manned them with many veterans of his own voyage

In 1500 Diaz sailed as one of the captains in a large fleet headed by Pedro Alvarez Cabral Their destination was India but they made a wide sweep into the South Atlantic and touched on the shores of Brazil Heading southeastward in the South Atlantic again they encountered fierce storms below the Tropic of Capricorn Four ships went down and all men aboard were drowned Among them was Bartholomew Diaz

DÍAZ (*de'ds*) PORFIRIO (1830–1915) The soldier statesman Porfirio Díaz built Mexico from a weak nation into the promising country it is today

Díaz was born Sept 15 1830 at Oaxaca of mixed Spanish and Indian blood His parents were poor Determined to better his position Díaz studied for the church and later read law At 17 he interrupted his studies to serve in the war against the United States After passing his law tests in 1853 he entered politics

At that time Mexico was torn by civil wars with numerous armed forces struggling for power Diaz seized the advantage afforded by the national unrest With ruthless daring he led revolts against the government until in 1877 he won the presidency of Mexico He was re-elected in 1884 and by special law served continuously until 1911

His dictatorial rule earned him the title of Iron Man of Mexico His entire regime was devoted to the economic development of his backward country and in his 30 years of power he achieved tremendous results However his disregard of the social needs of Mexico aroused public resentment and in 1911 a revolt forced him into exile in Europe He died July 2 1915 in Paris (*See also* Mexico)

DICKENS—CREATOR *of Immortal* CHARACTERS

DICKENS CHARLES (1812–1870) On a morning of 1841 a crowd of people were assembled on a pier in New York harbor They were eagerly awaiting the arrival of a tall sailing ship from England being towed to the pierhead There was no ocean cable as yet and the ship brought the latest news A shouted question went from the pier to the ship

Is Little Nell dead?

Little Nell was the child heroine in a serial story called Old Curiosity Shop The latest installment was on the ship and so eager were the people to learn how the story came out that they could not wait until the ship docked

The author who could stir people to such excitement was Charles Dickens then a young man of 29 Five years before with his Pickwick Papers he had leaped into celebrity such as had never before fallen to a writer The following year 1842 on his visit to America he was to receive a national reception second only to that of Lafayette in 1824

Dickens was small and energetic with clear blue eyes He dressed in bright colors and after he was 40 wore a "door knocker beard. This portrait was painted by W P Frith in 1859

Childhood of Dickens

As a child Charles Dickens enjoyed whatever advantages go with early adversity His father John Dickens was a minor clerk in the navy offices a genial man blessed with an abundant family (Charles was the second of eight children) and only a moderate income The family was unable to live within its income and they drifted from one poor home in London to another, each shabbier than the last Presently

John Dickens drifted into the Marshalsea Prison for debt and took his wife and younger children with him. Here for three months he lived the squalid life of a prisoner for debt. This episode his son was later to depict in the sometimes comic imprisonment of Mr. Pickwick and the more somber experiences of Mr. Dorrit under the shadow of the Marshalsea wall.

Meantime little Charles, in tears and drudgery, worked in a tumble-down blacking warehouse, lived in a garret, visited his family in prison on Sundays, and felt that his life was shattered before it had begun. For the account of it see 'David Copperfield', whose early troubles are those of his creator. Then something "turned up" to liberate Dickens senior. A timely legacy restored the family to something like gentility, and little Charles had a few quiet years at a private school.

Later he immortalized his father, for whom he always had a great love, as Mr. Micawber. When his own rising fortune and fame gave him control of a great newspaper, he put his father on the staff to preside with great majesty over the dispatches, bought him a small country house, and so allowed him a little autumn sunshine after his harassed life. Dickens' mother, unsympathetic and unconscious of his genius, meant less to him; she grudged his leaving work to go to school. Her too he made immortal, as Mrs. Nickleby, an unsurpassed picture of the "eternal feminine."

MR. PICKWICK ADDRESSES THE CLUB

This is one of the drawings by Robert Seymour, which furnished the inspiration for Dickens' immortal 'Pickwick Papers'. Hablôt Knight Browne ("Phiz") also illustrated some of the stories.

His Education Was Scanty

Dickens made his own career. A few years of secondary school constituted his education. He never attended college. His education came from his reading and observation and daily experience. In a sense, Charles Dickens was not an educated man. Except for the English novels of the 18th century, he knew little of the great literature of the past. Of history he knew practically nothing. His novels all deal with his own day, except his two historical novels—'A Tale of Two Cities' and 'Barnaby Rudge'—and these were set in the times of the French Revolution and the Gordon Riots, which were living memories to his elder contemporaries. Of foreign politics he knew little, nor did he care.

DICKENS' LIFE IN BRIEF. Charles John Huffam Dickens, born at Portsea (now a part of Portsmouth), Feb. 7, 1812; early youth in Chatham (1816–21); after that, London for the rest of his life, apart from travels and a country residence at Gad's Hill; reared in poverty; little school, no college; worked at the age of 12 at a menial job, later as a law clerk; taught himself shorthand and got a position as a reporter in the House of Commons' Gallery (1831).

As a reporter Dickens began writing sketches signed "Boz"; they met a ready reception. They were followed (1836–37) by the 'Pickwick Papers', a phenomenal success; Dickens threw himself into literature; stories fairly flowed from his pen—'Oliver Twist' (1838); 'Nicholas Nickleby' (1839); 'Old Curiosity Shop' (1841); 'Barnaby Rudge' (1841).

He married Catherine Hogarth in 1836. He received a triumphant welcome in America (January–June 1842); traveled in France and Italy; wrote 'Martin Chuzzlewit' (1844); 'The Cricket on the Hearth' (1845); 'Dombey and Son' (1848); 'David Copperfield' (1850); 'Bleak House' (1853); edited a weekly magazine, *Household Words* (1850). Dickens floated on a flood tide of popularity. Taking the platform (1858), he won fame as a lecturer. Clouds darkened his private life; he separated from his wife; from domestic trouble he sought solace in work. His books continued: 'A Tale of Two Cities' (1859); 'Great Expectations' (1861); 'Our Mutual Friend' (1865). With books, lectures (1859, 1861–62, 1866), and editing, he worked to the verge of exhaustion. A second lecture tour in America (1867–68) was overwhelming in success, but extremely fatiguing. Returning to England he refused to stop. On the evening of June 8, 1870, he suffered a stroke and died the next morning. He was buried in Westminster Abbey.

A DICKENS LANDMARK IN LONDON

This old build ng on Portugal Street Linco n s Inn Fields London is said to be the or ginal of the Old Curios ty Shop which Dickens described as the home of L ttle Nell and her grandfather

The qualities that made up Dickens genius d d not depend on formal education for development Dick ens had a reporter s eye for the details of da ly life and a mimic s ear for the subtleties of common speech Further he had the artist s abil ty to select what he needed from these raw materials of observation and to shape them into works of enduring merit

Preparation for a Career

By teaching himself shortl and D ckens secured the pos tion of court reporter in the old Doctors Com mons a survival from Elizabethan days that handled marriage divorce wills and other ghostly causes This experience gave D ckens the pecul ar contempt for law which never left him forever after it seemed either comic as in Bardell vs Pickwick or terrible with tragedy as in Bleak House Dickens moved up in 1831 to the Reporters Gallery of the old —the unburned and unreformed—House of Com mons He also went out to other cit es and towns report ng elect on speeches transcribing h s notes on the palm of his hand by the light of a dark lan tern in a post-chaise and four This experience gave him a detailed and sometimes cynical under standing of government To him tl e voters were often represented by the Eatanswill Election in Pickwick the parliamentary government by Doodle and Foodle and Coodle (Our Mutual Friend) and the civil service by the Circumlocution Office (Little Dorrit)

Thus equipped young Charles Dickens set out to conquer the world The stage was his first dream Night after night for two or three years he sat entranced with the melodrama of the London theaters lurid with love battle treachery and blue fire in which a heroic jack tar would knock over 16 smugglers like ninepins Melodrama put a stamp on Dickens for l fe His characters if they get excited drop into the ranting language of the old Adelphi Theatre On the other hand Dickens intense concentrat on on acting helped to g ve him that weird almost hyp notic power that he showed in the public reading of his works

Pickwick and Fame

However fate led him to a different career He had a passion for creative writing and he has told of h s throbbing joy of his eyes d m with tears when a manuscript sent anony mously to an editor appeared in all the majesty of print So he began writing sketches under the name of Boz the family nickname of a younger brother To Boz came a success so sudden that it literally staggered the read ing public The publishers Chapman and Hall had a plan for some serial pictures of cockney sportsmen a Nimrod club having all sorts of misadventures The humor of the day turned very much on such discomfitures and horse-play An artist named Seymour had drawn one or two p ctures They asked young Boz to wr te a set of stories to go with the p ctures Know ing nothing of sport Dickens suggested turning the Nimrod club from sport to travel When the publishers agreed then says Dickens I thought of Mr Pickwick which is all that anyone has ever known even D ckens of the origin and genesis of the greatest character in the world s humor The young author was to receive 14 guineas (about $70) for each monthly installment a ris ng fortune that lifted him to rapture and at the same t me to matrimony

The very week that the Pickwick Papers began their monthly appearance (April 1836) Di kens mar ried Catherine Hogarth one of the three pretty daugh ters of a newspaper associate The young couple moved into rooms in Furnival s Inn in a glow of pride and a whirl of importance to have a home of their own They d d not realize that one day they would separate with bitter words It was at the start a love match Dickens looked on Catherine beautiful and silent and saw nothing but the reflect on of himself and did not realize the emptiness of the m rror Catherine looked back at Charles and did not realize that genius and egot sm often lie close together Dickens indeed was not so much in love with Catherine as in love with love

DICKENS CREATED FASCINATING PEOPLE

Dickens' novels abound with secondary characters who are as memorable as the principals. At the left is Captain Cuttle, from 'Dombey and Son'. This retired sea captain is kindly, sometimes ridiculous, but with a deep sense of true dignity. At the right is Uriah Heep, of 'David Copperfield'. An oily and villainous bookkeeper, he is forever protesting that he is "an 'umble man."

With the marriage came the phenomenon of 'Pickwick'. At first the 'Papers' failed to sell—a few hundred copies only. Then into the book stepped Mr. Sam Weller, polishing boots at the White Hart Inn, and away went the narrative on the wings of imagination, down English lanes, past gabled inns, and along the highways as varied and as cheery as a flying coach at a gallop—and the world was at the author's feet. The 'Pickwick Papers' and the books that followed without pause lifted young "Boz" to the height of success, from poverty to wealth, from obscurity to fame, all in a few brief years.

America Welcomes Dickens

Dickens now looked around for other worlds to conquer. America had welcomed his books from the start, all the more cheerfully since the lack of international copyright permitted American publishers to print them without paying him. Dickens, in his youth a radical, hating Toryism and aristocracy, longed to study America and its freedom at first hand. Leaving their four children at home, he landed with his wife in Boston in January 1842. The town blazed with excitement; society was thrilled; there were dinners, receptions, adulation. Young Dickens, dressed in a bright velvet waistcoat, reveled in his new and adoring audience, writing home of the freedom of America and the comforts of the workers. Longfellow, Channing, and others of the New England elite joined in the welcome. Young Dr. Oliver Wendell Holmes was one of those who helped to organize it.

Dickens found in Boston friendships which he never lost, even when bitterness and disillusion altered his view of America. From Boston he went to New York and a "Boz" ball of 3,000 people; to Philadelphia and a huge public reception; thence to Baltimore and to Washington, where he met President Tyler and the Congress; thence to Richmond, which showed him what Southern culture could add to the more boisterous welcome of the North. Such was the triumphant progress of the young author, only a few years before a member of the shabby-genteel class of London.

Dickens Spurns America

Always ready to raise his voice in defense of a cause he believed in, Dickens spoke everywhere of the need for an international copyright agreement that would protect the rights of both American and British writers. He felt it unfair and unjust that American publishers should print and sell his books without permission from him and without paying him any royalties. Dickens did not speak of himself as the sole victim of this practice. He pointed out that all British authors were equally victimized; he also acknowledged that American authors, such as Poe, suffered from the pirating of their works in England.

BRUTAL BILL SIKES

In Oliver Twist Bill Sikes is a brutal burglar and henchman of the wicked Fagin The scene in which Sikes cruelly murders Nancy was adapted by Dickens into one of his most successful public readings

The American newspapers leaped upon these forthright statements and accused Dickens of bad taste and of abusing American hospitality In time Dickens rosy view of America faded This was not the America of his dreams for proof of it read American Notes his letters to friends and Martin Chuzzlewit The Americans all seemed to chew tobacco they kept slaves whom he never stopped to compare with factory slaves of England from whom went up unheeded the cry of the children American government seemed all plunder and roguery he forgot the sins of his own countrymen whom he had exposed in his novels Then he went West traveling as far as Cairo Ill The West finished him it seemed nothing but foul and reeking canal boats swamps bullfrogs and tobacco juice ending in the pestilential morass called the Mississippi

Dickens had no eye to see the pageant of America the great epic of the settlements of the West no eye to compare the commodious canal boat with the raft and the scow of earlier settlers He became peevish impatient of small discomfort resenting the fact that hotelkeepers should dare to talk to him He spent two weeks in Canada consoled there by the presence of friends at the English garrison in Montreal Then he returned home to rend America with his pen The odd thing is that the Americans after a little swearing at him soon forgave him for his exaggeratedly false depictions

Fame and Fortune

The years that followed Dickens return from America the middle period of his life were filled with activity fame and success He took a fine residence at Tavistock Square (1851) and lived in style though he never entered high society His friends were the leading authors artists and actors of the day Later on his purchase of a country house at Gads Hill fulfilled an ambition of his childhood His books appearing in monthly serial parts enjoyed a popularity that slackened only to rise again It is generally thought that David Copperfield written as a serial in 1848 and 1849 when he was at the height of his powers is the greatest of his novels The Pickwick Papers being scarcely a novel stands on other ground The two books show the transition of Dickens genius from the exuberant merriment of youth to the riper mind of middle age There is less echo of laughter and more tears

One book at least Dombey and Son is a sort of epic of sorrow Dickens books indeed appealed to his generation as much for their tears as for their laughter The Victorians ran easily to sentiment They liked to cry just as we like to laugh

Impetuous Journalist

With book writing went newspaper editing Dickens felt the need of reforming all England The way to do it he felt was to control and edit a great daily newspaper where he should preside like Jupiter handing out lightning Enthusiastic friends subscribed £100 000 and founded the *Daily News* Dickens threw himself eagerly into the editorial chair (January 1846) and threw himself out again in 19 days He found that in the newspaper business the lightning hits both ways So he founded instead a weekly journal *Household Words* and carried on with it and a later magazine *All the Year Round* (1859) till his death Several of his own stories Christmas Stories A Tale of Two Cities Great Expectations and others ran in his magazine

Many of the journal articles dealt with the social evils that Dickens saw everywhere about him He campaigned vigorously for reforms in prisons slums and poorhouses and he fought for free schools pure water and other vital public issues Contributions were unsigned and all were edited altered and revamped by Dickens who slaved away with scissors and paste

Dickens as Actor and Lecturer

Another activity and this a special delight to him was amateur theatricals that carried on Dickens love of the stage He himself had incomparable dramatic power With it he had a great talent for management and an energy and enthusiasm that carried all before it Once (May 16 1851) at a per

formance given at the Duke of Devonshire's London house for a charity, the young Queen Victoria and her Prince Consort and the Duke of Wellington were in the audience. The Queen came to a later performance (1857) and graciously "commanded Mr. Dickens' presence" after the show. Mr. Dickens being in "farce" dress asked to be excused from appearing, thus defying all precedents.

To theatricals presently he added public lecturing, or rather public readings from his works, that originated in his reading one of his famous Christmas stories to a group of friends. The result was a succession of tours in England, Scotland, and Ireland (1858–59, 1861–63, 1866–67, 1869–70). Dickens developed a phenomenal power on the platform. He read not only lighter scenes, as the trial in 'Pickwick', but scenes of tragedy (the storm at sea in 'Copperfield') and pathos (the death of little Paul Dombey). The effect was mesmeric. Something seemed to go out from him and clutch the audience. Again and again people fainted or sat immobile, frozen with horror, during his melodramatic scenes or roared and rocked in uncontrollable laughter at the lighter pieces. The strain on Dickens himself was terrific.

Dickens Leaves His Wife

All this time the shadows were gathering over a life outwardly resplendent. For years intimate friends had known that Dickens and his wife no longer seemed compatible. Presently the world learned, in a public notice sent forth by Dickens, that the husband and wife had agreed to part. When the world insisted on asking questions, Dickens was furious; he expected to enjoy at the same time the luxury of fame and the seclusion of obscurity. His friends maintained a conspiracy of silence even after his death.

Georgina Hogarth, his wife's younger sister, who had lived with them since 1842, had taken Catherine's place as companion and confidant. She remained with Dickens after the separation till his death; he left her a large part of his fortune. Dickens also saw much of Ellen Ternan, a young actress. He had made his wife an allowance of $3,000 a year out of an income of almost $150,000, but he left her well provided for in his will. Dickens also supported and educated their ten children.

Working to Death

After his separation from his wife, Dickens sought relief in the strain and excitement of work. His large family (there were seven boys and three girls to be provided for), his heavy expenses, and his recollections of early poverty made him anxious for money even in prosperity. He eagerly embraced the opportunity of a second American tour and carried it out (1867–68) with heroic resolution in spite of fatigue that was almost fatal. This time he avoided all public receptions and even private hospitality. It was the America of the close of the Civil War, throbbing with new interests, yet warm with heroic memories. Dickens, worn to death, had neither eyes nor ears for it. At home again, he resumed the strain of lecturing (1869–70).

For new sensations he worked up as a reading (from 'Oliver Twist') the killing of Nancy by Bill Sikes, till his audience shivered with horror. However, he was paying the price with his life. His sight at times failed. On the street, he could see only half of the letters on the signs; words slipped from him; his touch failed and his hands groped, feeling in the air. Retirement from the platform for the moment saved him. At a last appearance (March 1870) he said to a London audience, "From these garish lights I vanish forevermore," and over the great hall there passed a deep sigh.

In retirement he struggled with his last task, 'The Mystery of Edwin Drood', a tale of night and storm and murder. He guarded jealously the secret of the plot—all too jealously, for it died with him. The book was still unfinished on the evening in 1870 when Dickens sank stricken to the floor.

The Magic of Dickens

In the opinion of many, Dickens is England's greatest creative writer. His humor is unsurpassable, not only in the merry laughter that lies like sunlight on the surface, but in the warmth of human kindliness below. It is a sort of magic that can somehow shed a charm over a scamp such as Alfred Jingle and lend amusement to a damp horror such as Mrs. Gamp or a brute like Wackford Squeers. It is a transformed world in which somehow even the worst person appears as he might have been rather than as he is. The reader rejoices at the downfall of evil, but he pities rather than hates the evildoer.

In the years that have passed since 'Pickwick' appeared, people have been reading Dickens all over the world—in idle moments of happiness, in hours of loneliness, in the anxious vigils of the sick room, and in the long years of exile in distant lands—and finding always a temporary surcease of pain, a temporary oblivion of sorrow.

Books about Dickens

The standard work on Dickens is 'The Life of Charles Dickens', written by his great personal friend John Forster (Dutton, 1872–74; now published in two volumes by Everyman's Library). Most important among the critical works on Dickens are books by the late G. K. Chesterton—'Charles Dickens' (Dodd, 1906) and 'Appreciations and Criticisms of the Work of Charles Dickens' (Dent, 1911, o.p.)—and 'Charles Dickens: A Critical Study', by George Gissing (Greenberg, 1924, o.p.).

More recent studies are M. L. Becker's 'Introducing Charles Dickens' (Dodd, 1940); Hesketh Pearson's 'Dickens; His Character, Comedy, and Career' (Harper, 1949); A. H. House's 'Dickens' World' (Oxford, 1941, o.p.); Dame Una Pope-Hennessy's 'Charles Dickens' (Howell, Soskin, 1946, o.p.); Edgar Johnson's 'Charles Dickens: His Tragedy and Triumph' (Simon and Schuster, 1952).

R. J. Cruikshank's 'Charles Dickens and Early Victorian England' (Chanticleer, 1950) is a study of English life and customs from the time of the publication of 'Pickwick Papers' to Dickens' death.

MACHINES MAKE LETTER WRITING EASY

Instead of dictating a letter for his secretary to write in shorthand a businessman can talk into this dictating machine when convenient The machine records his words on a plastic disc

Later his secretary places the recording disc in her transcribing machine and plays it back As she listens to his message through a headphone she types it on the typewriter

DICTATING MACHINE In a modern office a businessman may answer his mail by talking through a hand microphone into a *dictating machine* The instrument registers his spoken words on a record made of various materials according to the type of machine Later his secretary puts the record on a *transcribing machine* As she listens through a headphone or a desk speaker she types the dictation

The dictating machine saves time and promotes efficiency A busy executive can dictate at his convenience without a secretary at his desk taking shorthand She can do other work while he dictates

The Evolution in Recording Thought

The dictating machine is the result of man s long quest for mechanizing business practices Centuries ago records were laboriously kept in hieroglyphics on papyri or clay tablets Isaac Pitman speeded up written communication by inventing shorthand in 1837 (*see* Shorthand) Letters were hand written until the typewriter was developed in 1868 (*see* Typewriter)

The story of the dictating machine begins with the phonograph The first to record and reproduce sound was Thomas A Edison in 1876 His device recorded sound on tinfoil wrapped around a cylinder When he spoke into a mouthpiece the sound waves vibrated a diaphragm and a needle attached to it dented the tin foil to varying depths according to the intensity of the sound In playing the record the needle followed the indentations and vibrated the diaphragm This moved the air and produced sound (*see* Phonograph)

In 1886 Chichester Bell and Charles Sumner Tainter associates of Alexander Graham Bell improved Edison s machine by cutting the tone groove into a wax coated cylinder Two years later, the manufacture of machines for the mechanical recording of sound for commercial purposes began They were powered by the treadle of the old fashioned sewing machine Later they were called dictaphones

In 1936 the first electronic dictating machines appeared They had vacuum tube amplifiers such as those used in radio to magnify sound Later other systems using plastic discs or belts were introduced They electronically emboss instead of cut a sound track on plastic Other systems use magnetized tape wire or discs These records can be mailed or filed Some recording media can be used over and over again by resurfacing or erasing them

With foot or hand controls the dictator or listener can start stop or play back all or part of

DICTATION IN THE MIDDLE AGES

Contrast this ancient dictation method with that of the machines above This painting shows a medieval Dutch executive dictating slowly while his secretary writes an elaborate script

the record. The dictator can correct words and indicate the length of each letter. The transcriber can reproduce the dictation at any desired speed.

Some dictating machines are no larger than a typewriter or a book. They are portable for use on business trips or at home or, with direct current adapters, in automobiles. Some systems combine dictating and transcribing machines in one unit.

Attachments permit the recording of telephone conversations and the "scrambling" of the message so that only authorized persons can reproduce it. Instead of each dictator having a machine, a number of dictators can be connected by telephone to one central recording instrument for greater efficiency.

Besides letters, dictating machines may also record conferences, minutes of meetings, speech rehearsals, and interviews. They are used for speech correction, taking inventory, and sales training. Doctors, authors, and lawyers use them in their work.

DICTATORSHIP. The word "dictatorship" goes back only to Roman times. It springs from the Latin verb *dictare*, which means "give a command." Dictatorship now means the rule of a nation by one man. But long before Roman times there were dictatorships. In early Egypt the Pharaohs were dictators. And in ancient Greece *tyrants* resembled modern dictators.

Tyrants commonly arose when a group of powerful citizens became arrogant and refused to share power with outsiders. A self-appointed leader would arouse the people with promises to remedy their grievances, and would then overthrow the existing group and govern in the name of his supporters. Some of these men, such as Periander in Corinth and Pisistratus in Athens, governed very ably. Seldom, however, did such men live out their days in peace.

But the Roman republic was the first nation to provide by law for a dictator when the republic was in danger. While the crisis lasted, he held all power. According to the law he had to give up his power after the danger had passed, usually within six months, and account for his acts. Cincinnatus was such a dictator. When the emergency was over, he returned to his farm (*see* Cincinnatus).

The modern dictator also comes to power in a crisis. But he gets control by force rather than by law. Nor does he retire when the crisis is passed. Rather, he usually invents new crises.

Today dictators are more absolute rulers than the ancient kings and tyrants, for they can command the armaments produced by modern industry. Conquest by outside powers may end their rule, but revolution is almost impossible. In a completely socialist state, such as Russia, the dictator may say who shall eat and who shall not, because the state owns all land, mines, and factories. No one can find work except in the service of the government.

The Rise of Modern Dictatorships

The United States fought the first World War, in the words of President Wilson, "to make the world safe for democracy." But before the war ended, the first great modern dictatorship arose in Russia. Disastrous defeats caused the czar's weak government to collapse in March 1917. In November Nikolai Lenin, leader of the small Bolshevik party, made himself master of Russia (*see* Lenin). Once in power, he outlawed all other parties, creating the first *totalitarian* (one-party) state. The Bolshevists then applied the revolutionary theories of Marxian socialism (*see* Marx). This brought a tremendous social upheaval in Russia.

Economic crises arose in other countries as a result of the war. In Italy, Benito Mussolini marched to power with the Fascist party (*see* Mussolini). Adolf Hitler, leader of the Nazis (National Socialists) became dictator of Germany in 1933 (*see* Hitler) He promised to make the "German, or Aryan, race" supreme in Europe. Both Mussolini and Hitler won support by opposing Communism. But once in power, they both moved toward collectivism.

Between the two World Wars, dictatorship spread to Spain and Portugal, to many small nations in eastern Europe, and to Turkey and Iran (Persia). The Shogunate hierarchy of Japan also adopted totalitarian practises. Then the second World War ended German Naziism, Italian Fascism, and Japanese militarism. But Communist totalitarianism spread from Russia over eastern Europe and into Asia.

Methods of Modern Dictatorships

In all totalitarian states, dictators gain absolute rule through "the party." That is the one political group permitted in the nation. Before Lenin died in 1924 Stalin got control of the Communist (Bolshevik) party (*see* Stalin). Stalin perfected the political machine Lenin had built and methodically grasped power that even the czars had never attained.

In a totalitarian state "the party" enters every part of the nation's life. It controls education, sets up a rigid censorship, and spreads propaganda in the press, on the radio, and in the theater. It plans even the people's leisure time, organizing sports and games, even to chess and hiking. It creates children's clubs and youth organizations to develop "love" for the dictator, their "leader." They also learn that their "duty" is to obey the dictator. The party gains control of labor unions and industry, and organizes a secret political police to seize anyone even suspected of opposing the dictator.

Dictators Seize on Scapegoats

If the people are discontented the dictator sets up a "scapegoat" to take the blame. For example, Lenin and Stalin "liquidated" the wealthy, the bourgeoisie (middle-class townspeople) and the kulaks (well-to-do peasants), and then worked up hate against the "war-mongering imperialistic" democracies. Hitler blamed the Jews for Germany's troubles and exterminated millions of Jewish people. Concentration camps, used by Soviet Russia to imprison "liquidated" persons, were imitated by Hitler.

Dictators who hold unlimited power over their own people, without any legal restraints, rarely respect international law and the rights of other nations They frequently violate treaties they have signed

They prepare for war and seek to gain their objectives by force. Efforts of the democracies to negotiate with Hitler resulted in appeasement, then deadlock, and finally war (*see* Chamberlain, Europe). Stalin also disregarded treaties. Russia, moreover, annexed foreign territories. Conferences between Russia and the democracies repeatedly ended in deadlock in the Council of Foreign Ministers and in the United Nations.

Weaknesses of Dictatorships

Dictatorships may work well for limited periods. In emergencies, they can act quickly. In wartime, for example, even democracies allow the government almost dictatorial powers, as in ancient Rome.

Sound governments provide for peaceful continuance of rule. When a monarch dies his heir ascends the throne. Democracies also provide for continuity of government. But when a dictator dies the nation is in chaos until another "strong man" seizes control.

Dictators who remain in office tend to be corrupted and misled by their own power. Their closest advisers become flatterers. No one dares to offer blunt criticism. The dictators rule by fear and they live in dread of assassination. Time after time their fear drives them to "purge" even the party.

For the masses life in a totalitarian state means loss of all individual liberty and monotonous regimentation. Freedom of speech and of the press, freedom of political organizations, guarantees against arbitrary arrest and other civil liberties simply do not exist under a dictatorship. (*See also* Communism, Fascism, Russia, Italy, Germany.)

DICTOGRAPH This device, which works on the principle of the telephone, is used chiefly to communicate between business offices within a building. In each of the offices is a small box containing a transmitter, or microphone, and a receiver, or loud-speaker. Contact is made with another dictograph user by flipping a key on the box. The person talking needs no mouthpiece, for the microphone is so sensitive that it can pick up a whisper several yards away. The person listening in another office needs no earphone, for the loud speaker can be heard across a large room.

Another application of this device is the detective dictograph, used to trap criminals. This is essentially a sensitive microphone, hidden in the suspect's room. The words picked up by the microphone are conveyed by wires to a stenographer wearing earphones, and the notes so obtained may be used as evidence.

DIESEL ENGINE Of all internal combustion engines the Diesel type can extract the most energy from fuel. It obtains nearly twice as much work as a gasoline engine from a comparable amount of fuel. It is several times more efficient than a steam engine. But this efficiency appears only in a narrow range of speeds, and the Diesel is much too heavy for most automobiles and airplanes. It is especially suited for running small ships, for generating electric power, in Diesel-electric locomotives, and for all kinds of stationary engine work.

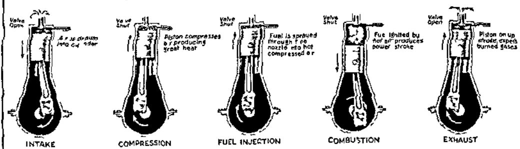
The Diesel engine runs best on a special grade of fuel oil, about the same as is used in home oil furnaces. Many other fuels have been used successfully.

How the Diesel Engine Works

Like most gas engines, the Diesel works on the cylinder and piston principle (*see* Internal Combustion Engine). The arrangement of cylinders varies. They may be in line, in a V, or opposed. They may also be in a radial arrangement, like spokes in a wheel. Several radial groups, stacked one on top of the other, make up a "pancake" engine.

Operation starts as the piston pushes the air into one end of the cylinder. Here the air is compressed to 1/16th of the space it would normally occupy. (Engineers call this a 16 to 1 compression ratio.) The compression heats the air to about 1,000° F. At this point the fuel is injected into the cylinder. It catches fire like the flashing of grease in a frying pan. The explosion of the gas formed by the ignited fuel and compressed air pushes the piston to the

HOW THE DIESEL ENGINE OPERATES



Compare this simplified diagram of a four cycle Diesel engine with that of the gasoline engine in the Automobile article. The first two strokes of the cycle are almost the same. The important difference is in the fuel intake and ignition. At the top of the second stroke the air in the cylinder is so highly compressed that its temperature rises to about 1,000° F. When the fuel is injected it ignites spontaneously without the need of a spark. The rest of the cycle is similar to that of the gasoline engine. Fuel of low volatility can be used: molasses, crude oil, shale oil, fish oil; even powdered coal have been successfully used in these engines, which require little supervision. Small Diesels are usually started by ordinary electric starters; big engines use compressed air. No "warming up" is needed.

other end of the cylinder. This is the power stroke that turns the crankshaft.

The system of fuel injection is the heart of the Diesel engine. Each cylinder has a pump which forces the fuel oil through a nozzle fitted with a number of fine holes. The oil is blown through the holes at a terrific speed. It breaks up into a fine spray which ignites immediately in the hot air to produce a powerful explosive force. The fuel injector also regulates the speed of the Diesel. It varies the amount of oil injected into the cylinder and thus controls the force of the power stroke.

Diesel engines operate either on a four-stroke cycle or a two-stroke cycle. The first is shown in the diagram on the preceding page. It has one power stroke in every four. The two-stroke cycle gives a power impulse in every two strokes. In this type each upward movement of the piston compresses air and the fuel is injected near the top of the stroke. Each down stroke starts with delivery of power from the exploding fuel. Toward the end, air is admitted and sweeps out the burned gases. Air is supplied by a blower. In the four-stroke engine, air is pulled into the cylinder by the intake stroke.

Invention and Swift Development

In the late 1870's Rudolf Diesel (1858–1913?) was an engineering student at the Munich Technical College in Munich, Germany. There he heard a professor describe the low efficiency of the steam engine. Diesel determined to build a new type. His first model, built in 1892, almost killed him when he tried to start it. But by 1897 Diesel had constructed a successful engine, using powdered coal as the fuel. The first Diesel engine for commercial service was installed in St. Louis, Mo., in 1898. Within a few years, thousands of Diesels were in use. Diesel continued to make improvements. He gained a fortune and high honors from his invention. In 1913 he mysteriously disappeared from a steamer on which he was crossing the English Channel. His important papers were missing also. No definite proof of his death was ever offered.

Today Diesel engines are used widely. They have become progressively cheaper, lighter, and more efficient. Engines range in size from 15 to 1,500 horsepower. Diesel-electric locomotives haul crack passenger trains at record speeds, pull heavy freight loads up mountain grades, and perform switching duties at railroad yards. Cross-country truck and bus operators use Diesels because of their low operating cost. Marine Diesels are in use in tugs, freighters, and smaller passenger ships and on many naval vessels.

The Diesel is favored as a cheap and efficient power source in electricity plants, factories, mines, and pumping stations. Diesel motors drive pumps, air compressors, tractors, hoists and winches, air-conditioning and refrigeration machinery, power shovels, and many other industrial machines and tools.

DIGESTION—*How the* ALIMENTARY CANAL *Does Its* WORK

DIGESTION. What happens to food after it is eaten? We all know it is used by the body for energy and growth. To be used, however, food must be changed into a form that can be carried through the blood stream.

Digestion is the process which changes food—carbohydrates, fats, and proteins—into soluble products that can be used by the body. The illustration at the right shows how protein is taken apart and rebuilt into a simpler form. Both mechanical action and chemical action are necessary to do this.

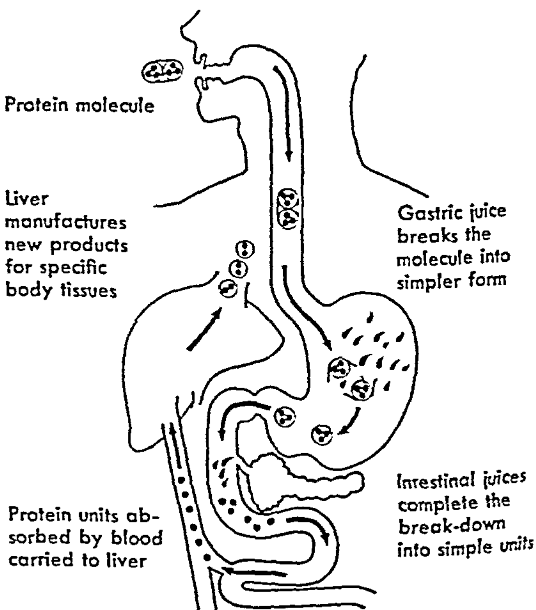
Human digestion takes place in a long tubelike canal called the *alimentary canal*, or the *digestive tract*. The whole canal is lined with a *mucous membrane*. The structure of the digestive tract is shown in drawings on the following pages.

Where Digestion Begins

Digestion begins in the mouth. Here the food is cut and chopped by the teeth. The tongue helps mix the food particles with a digestive juice called *saliva*, which is made in the mouth. Saliva moistens the food so it can be swallowed easily, and it changes some starches into simple sugars. This is the first step in digestion.

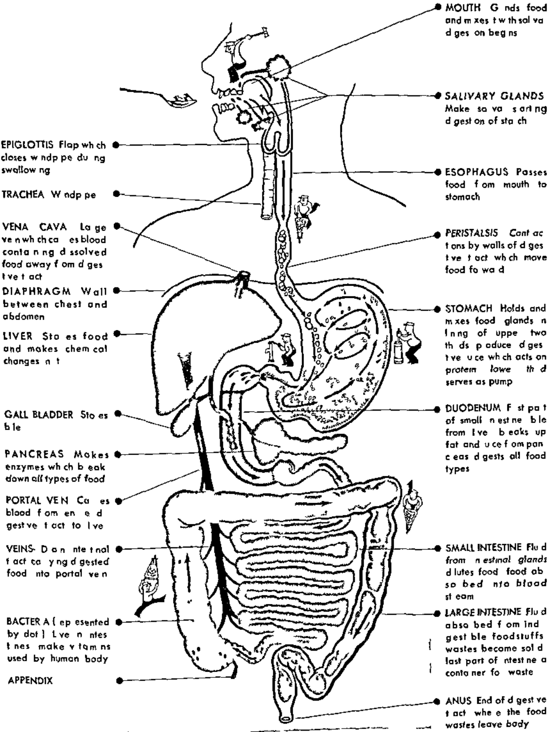
It is important to chew food thoroughly to mix it well with saliva. Thorough chewing cuts food into small pieces which are more easily attacked by digestive juices. Food should not be washed down with quantities of liquid to avoid chewing.

THE STORY OF A FOOD MOLECULE



Before food can be used by the body for energy and growth it must be changed into simple form. This drawing shows how a protein molecule is changed by the digestive juices in the stomach and small intestine before being passed on to the liver.

WHERE FOOD IS MADE READY FOR USE BY THE BODY



P ma y digest ve o gans n ed secondary d ges ve o gans n g ay

From the mouth the food is swallowed into a transport tube, named the *esophagus*, or *gullet.* A flap called the *epiglottis* closes the windpipe while food is being swallowed. *Peristalsis,* a wavelike muscular movement of the esophagus walls, forces food down the tube to the stomach. Peristalsis takes place throughout the digestive tract. It is an *automatic,* or *involuntary,* action, which is carried out in response to nerve impulses set up by the contents of the tube. When digestion is working normally we are unaware of the movements of the gullet, the stomach, and most of the intestine. Swallowing is a *voluntary* muscular action.

Work of the Stomach

At the bottom of the esophagus there is a muscular valve, or *sphincter,* through which food enters the stomach. This sphincter muscle keeps food in the stomach from being forced back into the esophagus. Peristalsis in the stomach churns the food and mixes it with mucus and with *gastric juices,* which contain *enzymes* and hydrochloric acid (*see* Enzymes). These gastric juices are secreted from millions of small glands in the lining of the upper stomach walls. Drawings of them are shown below on this page. These glands pour about three quarts of fluid into the stomach daily. Similar glands in the small intestine also secrete enzymes and fluid. Hydrochloric acid secreted by the stomach sets up the sour or acid condition necessary for digestion. Certain remedies for indigestion are advertised as correcting this acid condition. If these remedies actually do get rid of the stomach acids it is not wise to take them. Acid is required for digestion in the stomach.

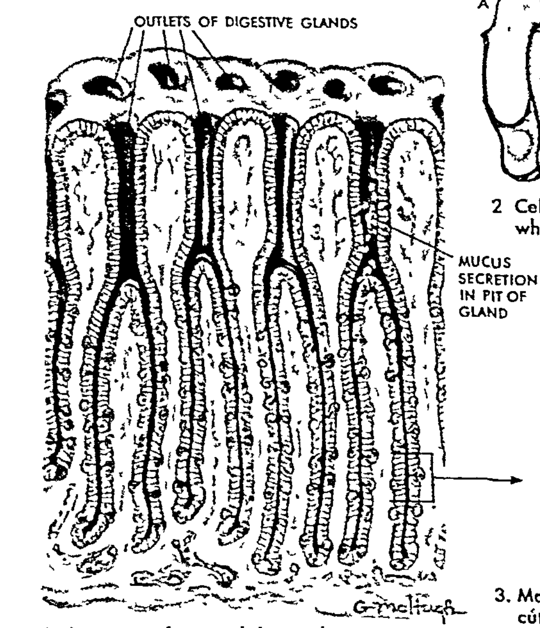
The stomach churns the food into a thick liquid, called *chyme,* before it is passed on by peristalsis into the small intestine (*see* Stomach). Another valve, or sphincter muscle, controls the rate at which chyme is passed out of the stomach into the *duodenum,* which is the name of the upper small intestine. The duodenum is about ten inches long.

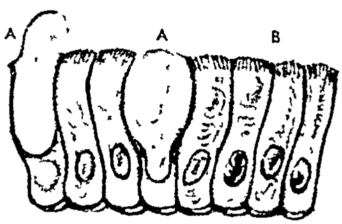
Little by little, as the digestive process in the stomach is completed, all the chyme is passed through the sphincter into the duodenum. This peristalsis is regulated in part by chemical products called *hormones* and in part by nerve responses (*see* Hormones). This process does not take place all at once. It continues over a period of time.

It takes from 30 to 40 hours for food to travel the length of the alimentary canal. Different kinds of food are held in the stomach for varying lengths of time. Starch and sugar are held in the stomach for a short time only, usually no more than one to two hours. Protein foods are there from three to five hours. Fat foods may remain in the stomach even longer than proteins. This is why eating a heavy dinner of meat, potatoes, and gravy satisfies our hunger longer than one made up of sweets or greens. Food made up of easily digested carbohydrates passes quickly from the stomach and into the small intestine

The stomach is an extremely important organ, but it is not essential to life. People who have had their stomachs removed are frequently able to live

STRUCTURE OF THE LINING OF THE DIGESTIVE TUBE

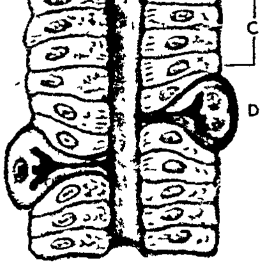




2 Cells of the mucous membrane, which lines digestive tract

1. The mucous membrane of the stomach is honeycombed with millions of glands that secrete mucus, enzymes, and acid. These secretions do the chemical work of digestion

2. Cells (A) are mucus-secreting cells. These are called "goblet cells" because of their shape and because they hold the mucus. Cells (B) that secrete enzymes and fluid are called columnar epithelial cells.

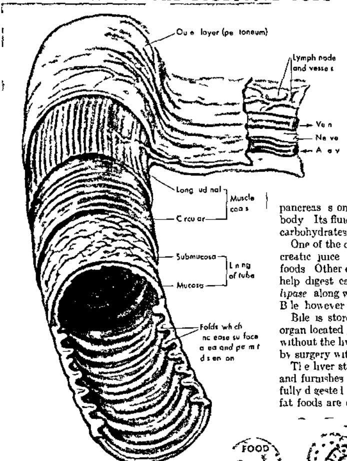


3. Magnified view of gland tubule cut down through the middle

1 A section of stomach lining showing glands

3. Cells lining the tubules in the stomach glands are of two kinds. Chief cells (C) that are modified epithelial cells which secrete enzymes, and acid-secreting cells (D) that are only found in the stomach.

STRUCTURE OF THE DIGESTIVE TUBE



by taking special foods in small quantities many times a day. The small intestine is then able to perform all necessary digestion.

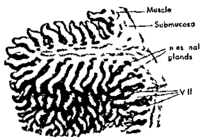
Work of the Small Intestine

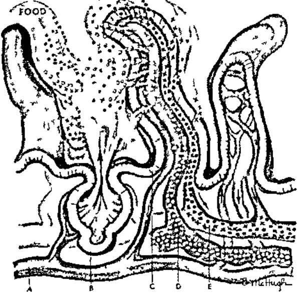
Food products remain in the small intestine for several hours. Two large glands, the liver and the pancreas, connect with the small intestine by *ducts* or tubes. Through these ducts the liver and pancreas pour secretions which further aid digestion. Fluid from the pancreas is called *pancreatic juice*. Fluid from the liver is called *bile*. Although the pancreas is only finger-sized, it secretes about a pint of pancreatic juice a day. The pancreas is one of the most important glands in the body. Its fluid is the great digester of all food types: carbohydrates, protein, and fat.

One of the digestive enzymes contained in the pancreatic juice is *trypsin*, which helps digest protein foods. Other enzymes are *amylase* and *maltase*, which help digest carbohydrates. The pancreatic enzyme *lipase*, along with bile from the liver, helps digest fat. Bile, however, does not contain important enzymes.

Bile is stored in the *gall bladder*, a small hollow organ located just under the liver. We could not live without the liver, but the gall bladder can be removed by surgery without serious effect.

The liver stores *glycogen* for later use by the body and furnishes clotting material for the blood. When fully digested, proteins are changed into *amino acids*, fat foods are changed into *fatty acids*, and carbohy-





The large picture at the top shows the layers that make up the walls of the small intestine. The inside layer is in the form of folds. These increase the surface area and help in food absorption. They also permit the tube to enlarge, or distend itself. The small picture above shows a part of the intestinal lining greatly enlarged. Fingerlike villi further increase the surface area. At right is a magnified section of the villi and of a digestive gland. Shown here are (A) an artery, (B) a digestive gland, (C) cross section of a villus, (D) a lymph vessel which transports fats, (E) a vein. White symbols indicate fat (in lymph). Black symbols indicate proteins and carbohydrates.

drates are changed into sugars. These soluble food products are dissolved and then absorbed into the blood stream through the walls of the small intestine.

While food is in the small intestine it is further diluted by *fluid secreted by the intestinal glands at* a rate of from five to ten quarts daily. The length of the small intestine is about 21 feet. By the time the diluted food products have traveled its length most of their valuable substances have been absorbed into the blood stream.

How Food Is Absorbed

The lining of the small intestine contains many folds. These folds increase the surface area which can be in contact with the food products. The lining surface of the intestinal folds is further increased by many fingerlike projections called *villi*. These are shown greatly enlarged in the pictures on the preceding page. The digested food is passed through the cell membranes of the villi into the blood and *lymph*, which carry it to the cells. The body can then use the food for energy and growth (*see* Blood).

Peristalsis moves the undigested parts of food from the small intestine into the large intestine. Peristalsis continues in the large intestine but at a much slower rate than in the small intestine or stomach. Although the large intestine is only five or six feet long, from 10 to 20 hours is required for waste material to pass through it. Here most of the water which was mixed with the food is removed through the walls of the large intestine. The waste is turned into solids which are passed from the body by excretion. A semivoluntary sphincter at the anus controls excretion.

In addition to the rectum and anus, the large intestine is made up of three parts, the ascending colon, the transverse colon, and the descending colon (*see* Physiology). The contents of the small intestine enter the ascending colon through a sphincter muscle, which prevents their return. This sphincter is similar to the other sphincters through which food enters each part of the digestive tract. In the ascending colon fluids and salts are absorbed. Water taken with meals is absorbed here. Water drunk between meals is mostly absorbed in the small intestine. In the transverse colon more water is removed from the waste materials until they are in solid form. The descending colon is a container for waste.

In the colon there are large numbers of bacteria. These bacteria aid in digesting the remaining food products. They also produce *folic acid*, which prevents anemia, and several vitamins which are important to health (*see* Vitamins).

How Plants and Animals Digest Their Food

Enzymes help plants and animals digest their food just as enzymes help man digest his. An *enzyme*, *diastase*, helps plants break starch down into sugar. Another enzyme, *maltase*, acts upon malt sugar. Some plants produce fat foods. *Lipase*, another enzyme, changes these fats to usable forms for the plant. Proteins too must be changed before plants can absorb them (*see* Enzymes).

Meat-eating, or *carnivorous*, animals have digestive systems which are shorter and simpler than plant-eating, or *herbivorous*, animals. Plant-eating animals frequently have longer small and large intestines made up of several additional sections. The cow, for example, has four sections to its stomach (*see* Animals; Ruminants; Stomach.) Bacteria in the intestines of herbivorous animals do much of the digestive work.

DIOGENES (*dī-ŏg'ĭ-nēz*) (412–323 B.C.). Many stories are told of this eccentric Greek philosopher. At one time, it is said, he was seen carrying a lantern through the streets of Athens in the daytime. When he

DIOGENES AND HIS LANTERN

When people asked Diogenes—as he knew they would—why he carried a lantern, he answered, "I am seeking an honest man."

was asked why he was doing so, he answered, "I am seeking an honest man."

Diogenes came to Athens from the Greek colony of Sinope, on the Black Sea. He adopted the philosophy of the Cynics, who taught that to attain wisdom and virtue one must give up all the pleasures of life, which stand in the way of self-mastery. So he got rid of all his possessions, except a cloak and purse and a wooden bowl. He even threw away the bowl as unnecessary, when he saw a boy drinking from the hollow of his hand. He lived in a cask or tub.

At one time he made a voyage and was captured by pirates. They sold him as a slave in Crete. When asked his trade he replied that he knew no trade but that of governing men and that he should be sold to a man who needed a master. He was sold to a master who took him to Corinth to conduct the education of his children. There he became famous.

Once Alexander the Great came to see him at Corinth and asked him if there was any favor he could do him. Diogenes replied that the only thing Alexander could do for him was not to stand between him and the sun. Diogenes died at Corinth and a pillar was erected to his memory.

DIONYSUS (*dī-ō-nī'sŭs*) A beautiful youth was wandering alone on a sea beach in Greece—so the old story tells us—when a band of pirates approached Knowing that his beauty would command a good price in the slave markets of Asia they seized the youth and carried him to their vessel But there the fetters dropped from his limbs

"We have tried to bind a god! " cried the pilot, as he beheld the miracle "Let us restore this youth to the spot whence we took him, lest the immortals afflict us with adverse winds and storms "

Heedless of these words, the pirates set sail for the open sea But presently the ship stood still Tendrils of ivy twined about the oars The masts and sails were quickly covered with vines laden with ripening grapes Strains of magic flutes were heard and streams of fragrant wine trickled over the vessel

The terrified crew entreated the pilot to steer for the shore But it was too late The youth changed into a roaring lion, rushed upon the captain and tore him in pieces The sailors leaped overboard and were changed into dolphins Only the pious steersman escaped this fate The captive resumed his true form as the great Dionysus, the god of the vine and the growing principle of nature

This is but one of the many adventures that befell Dionysus, during a time when he lived on earth and traveled from country to country, teaching men to cultivate the grape and to make wine Often he rode in a chariot drawn by lions and leopards and was attended by satyrs and bands of dancing women called Bacchantes

Dionysus was the son of Zeus (Jupiter), the god of the sky, and of Semele, a goddess representing the earth *The Romans called him Bacchus* In his early years he was cared for by an aged satyr named Silenus, who remained one of his favorite companions Dionysus was represented in works of art as a beautiful youth, crowned with vine leaves or ivy and wearing a faun skin over his shoulders His festivals were celebrated with processions dances, and choruses, out of which grew the Greek drama and the Greek theater In Rome the Bacchanalia, or festival of Bacchus, was celebrated every third year but it became so immoral that in the year 186 B C the Roman Senate forbade it (*See* Drama)

DIPLOMATIC SERVICE Every nation maintains agents called diplomats to protect and promote its interests in foreign countries They work under the direction of an official of the home government called the foreign minister or, as in the United States, the secretary of state (*see* United States Government, section on the Department of State)

Before the days of rapid communication by telegraph, cable and radio diplomats were accredited in four ranks or grades, according to their authority to speak for their country First came the ambassador His word in negotiations was considered decisive and binding upon his country Next came a minister *plenipotentiary*, who was sent on special missions with an authority equal to that of an ambassador The third grade was a minister resident, who handled routine affairs but lacked the full authority of an ambassador The last grade was that of chargé d affaires, who exercised temporary authority in the absence of a diplomat with superior authority

Modern Workings of Diplomacy

Today these distinctions of authority have largely disappeared, since diplomats of every grade can refer *important matters instantly to their home governments* for decision The distinction survives chiefly in social prestige and dignity Leading nations accredit diplomats to other important nations as ambassadors These officials maintain impressive headquarters called *embassies* and on formal occasions they take precedence over everyone except heads of governments The Vatican calls its representatives *nuncios* but they rank as ambassadors Less important posts are entrusted to ministers who maintain *legations* The least important posts or those temporarily vacant are held by chargés d affaires Attaches are representatives of army navy or air services who are classed as diplomats but they act as observers for their services and do not conduct diplomatic negotiations On special occasions international bodies such as the United Nations and the Organization of American States may conduct negotiations

Diplomatic representatives are immune to arrest for minor offenses in the country to which they are accredited, and their residences are considered part of the soil of their home countries In event of war, they are granted safe conduct home

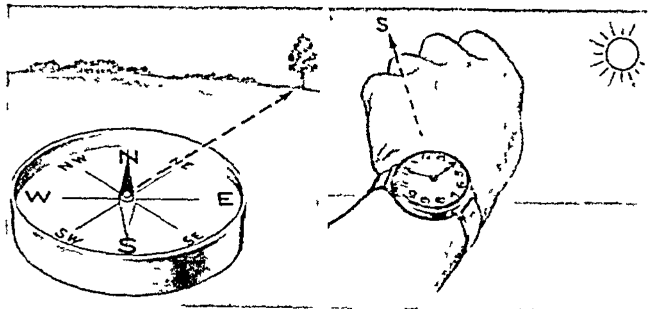
Diplomats have been important officials since the time of the Byzantine Empire At first, ambassadors were sent only on special missions to the barbarians or to Rome But these proved so valuable that Venice began sending permanent representatives to neighboring states and the custom soon became general The different grades of diplomats were established by the Congress of Vienna in 1815

Ambassadors and ministers are appointed by the highest authority in a government—in the United States, by the president They are assisted by secretaries of various grades In the American service these positions are under civil service, and vacancies at the bottom are filled by competitive examination Training for the work is given in a Foreign Service Institute in the Department of State

The Important Consular Service

In addition to diplomats all larger countries maintain consuls in foreign lands Consuls are commercial representatives, ' a nation s lookouts on the watch-towers of international trade " They are stationed at all the important centers of commerce in the world and not only supervise exports to their own countries, and give advice and help to their countrymen abroad but they also seek out commercial opportunities in foreign lands and report these to their home governments In the United States, these reports are sent to the Department of Commerce and distributed to business industry and libraries in the department s *Foreign Commerce Weekly* or in special bulletins

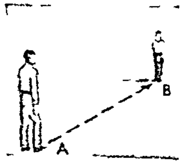
How We Know DIRECTIONS *and* FIND *Our Way*



Two handy direction finders are the compass and a watch. To use a compass, lay it flat and turn it until the N on the card is under the north-seeking needle. Then you can tell directions by sighting across the compass. The lone tree in the picture, for example, is northeast. You can use a watch as a compass on sunny days by pointing the hour hand at the sun. Halfway between it and twelve o'clock (standard time), the direction will be roughly south. You can read more about these and other methods in this article

DIRECTIONS. Everyone should be able to find his way about in unfamiliar places. In remote open country this ability is essential; many have lost their lives because they could not tell directions. We should all know how to use a compass (or get along without one) and be able to read a map.

To start, we must know what a direction is. It is not a place we go to. It is a *line* or *course*. If you are at A (little picture) and your friend is at B, the line between A and B marks a direction. To join your friend, follow this line. Your friend's place at B is not your direction. It is your *destination*.



Most of us know the directions north, south, east, and west. We see them marked on compass cards as N, E, S, and W. They are called the *cardinal points* of the compass. Between them are other directions such as northeast (NE). You can find more about compass directions in the article Compass.

Using the Compass

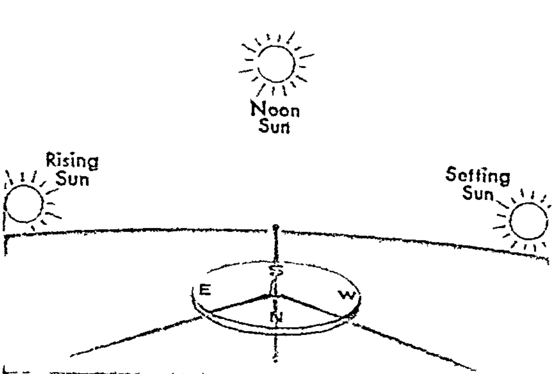
How do we find and follow directions? The best way is to use a compass. It works because the compass needle will always swing until it lies in a north and south line. On most compasses, the needle end that points north is marked with dark color.

But the compass will not tell directions unless it is used correctly. You are very likely to get wrong directions if you try to use it while you are walking. You should set it down flat, being careful that no iron or steel is near by. Wait until the needle comes to rest. Then turn the compass carefully until the N mark on the card is straight under the north-pointing end of the needle. Now your compass is ready for use and you can tell directions.

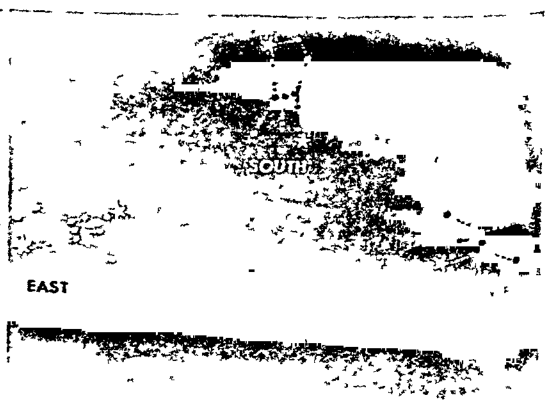
To do so, remember that the directions run out everywhere from the pivot of the needle. So to tell any direction you must look along a line over the pivot. For an example, look at the picture at the top of the page. Suppose you want the direction to the lone tree on the horizon. Get on the side of the compass *away* from the tree and look over the pivot at the tree. Your line of sight will cross a marking on the card. That is the direction. In this example it is northeast (NE).

The picture also suggests how to keep a direction when you are walking. Suppose you are in the locality shown and you want to go northeast. Do not try to keep your direction with the compass while you walk. Place the compass correctly on the ground and look northeast from the needle pivot. Pick out some landmark in that direction and walk toward it. In this example, the lone tree will be your landmark. When

The Sun and the Stars Can Tell Us Directions



We can use the sun or shadows to tell directions. If we set up a shadow stick, the rising sun will cast a long shadow to the west. The shadow will lie north of the stick at noon and will vary with season from southeast to northeast at sunset. (It will be more southwest in summer and northwest in winter.)



The constellation Orion, with its belt and sword, is good for finding directions on a clear night. Early in January it rises in the east after sunset and crosses the sky through the night. Early in March it is due south after sunset. Late in April it is about to set in the west when night comes.

you reach it, use the compass to select another landmark. If you are in thick bushes or trees, use the compass to tell the direction of the sun and the shadows it casts Compare them with the direction in which you want to go. Then use the sun or the shadows as your guide and check often with the compass

Star and Sun Directions

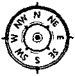
The stars and the sun can also be used for directions The best way at night is to take direction from the North Star An easy way to find it is explained in the article on Astronomy To find other directions by this method, face the North Star East will be at your right, west at your left, and south at your back

Other constellations of stars will tell directions, if you know how to use them A picture on the opposite page tells how to use the constellation Orion You can use others, once you learn to recognize them But you must know how they move during the night and how they change their places in the sky from month to month

The sun too tells directions An easy one to check is south The sun will be in the south at noon You can check the time by watching a shadow if you do not have a clock or watch At noon, the sun is at its highest for the day Therefore, it casts the shortest shadow If you mark the end of a shadow when it is shortest, your mark will be north of the sun

Can You Pass this Quiz on Directions?

1 How do you find the directions east or west of where you live?
2 On a clear night how can you find which direction *is north?*
3 How do you find directions on a globe? On a flat map?
4 What capital city in Europe is due east of New York? Berlin London Madrid or Rome?
5 In St Lou s what American city is due south? east? west?
6 On the earth s surface what is down ? What is up ?
7 Can an airplane go east or west while it is going up at take off or down for a landing?
8 Is it correct to say up north and down south ?
9 Does the St Lawrence River flow up ?
10 On a trip to the moon what would happen to up and down ?



For answers, read this article

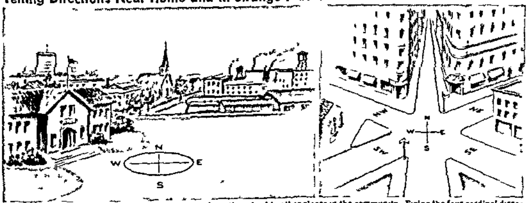
The sun marks other directions at sunrise and sunset In June, it rises nearly in the northeast and sets nearly in the northwest In December it rises more toward the southeast and sets toward the southwest *In other months* the positions are between these limits They can be checked easily by making a shadow board Simply set a thin *stick* upright on a board and mark where the shadows fall at different times

With a watch *you can* tell directions roughly from the sun at *any* time of the day Simply *point the hour hand at* the sun Halfway between the hour hand and noon will be south In the morning you use the left side of the watch In the afternoon you use the right side If the watch shows daylight saving time, use one o'clock instead of noon This method works better at some seasons than at others because clock time and sun time are not always the same, and for other reasons (*see* Time)

Directions in Cities

In your home community you have no trouble with directions But many people get confused or lost in strange cities and towns Hasty first impressions cause much of the trouble For example, many visitors in San Francisco get an idea that the main thoroughfare, Market Street, runs east and west It does

Telling Directions Near Home and in Strange Places



A school class can practice by learning the direction from the school to other places in the community Fixing the four cardinal directions (north east south and west) in the school yard is a good way to start. Another good habit is learning to fix directions *in any strange city or town you visit* In many American towns, the streets run north south east, and west But this is not always true The picture at the right shows how one street may run north and south while the others are on a slant with the cardinal directions Such facts can be learned by consulting a street map Doing so will prevent getting confused or lost in a strange town.

not. It runs more nearly northeast and southwest. But visitors get the wrong impression and they are confused as long as they stay in the city.

A good rule is to check directions as soon as you enter a strange city or town. If you can see the sun or stars, this is easy. If not, get a street map and examine it.

Most automobile travelers use road numbers and signs to find their way. But it is easy to become confused and to follow road numbers the wrong way, unless you check. The best way to check is to use a road map. Watch it for the towns ahead on the road you want. Then watch the signs for the names of these towns. Watch the sun also. If you are going east, it will be ahead of you in the morning, at your right at noon, and behind you in the afternoon.

Finding Directions on a Globe

Even if you are not out of doors or traveling, you still need to know about directions. Many questions about directions come from studying geography. Events in the news make you wonder where places are and what their relations are to other places. These questions can be answered by using globes or maps. But you must know the right way to use them.

The three pictures on this page show how to use a globe correctly. You will soon find that you cannot tell directions by simply looking at the globe or measuring. But you can do so easily by using the lines for latitude and longitude.

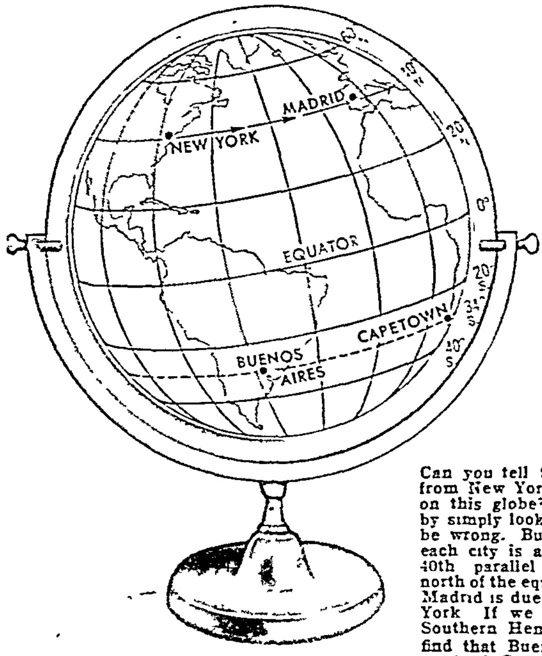
The horizontal or "left and right" lines are parallels of latitude. They always point exactly east and west. The "up and down" lines are meridians of longitude. They point exactly north and south.

The parallels circle the globe and are always equal distances apart. This keeps them parallel, so they never come together. But the meridians come together at the North Pole and at the South Pole. They are farthest apart at the equator. Each kind of line is numbered in degrees, as explained in the article on Latitude and Longitude.

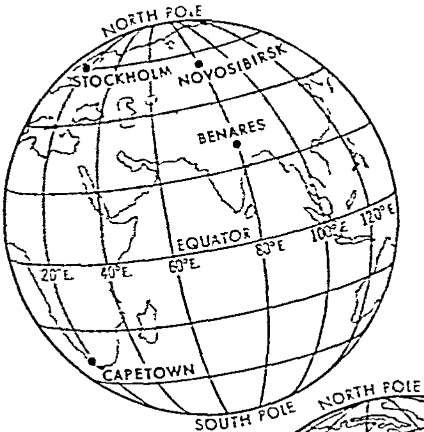
Now notice another important fact about these globes. Each one has its axis tilted 23½ degrees from the vertical (straight up and down). They are drawn this way because the earth is tilted relative to the sun at this same angle. So most globes are mounted to have this same tilt. That is why we are sometimes misled when we try to find directions by looking at a globe.

We think that north is "up" and south is "down." But this is not true. North is the direction toward the North Pole. South is toward the South Pole; and each pole is tilted away from being up or down. But the meridians always point toward the poles, wherever they are on the globe. So they always show north

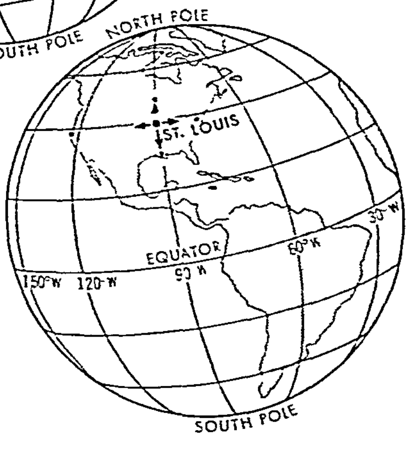
Finding Directions on a Globe



Can you tell the direction from New York to Madrid on this globe? If you try by simply looking, you will be wrong. But notice that each city is about on the 40th parallel of latitude north of the equator. Hence Madrid is due east of New York. If we look at the Southern Hemisphere, we find that Buenos Aires is west of Capetown on the 34th parallel.

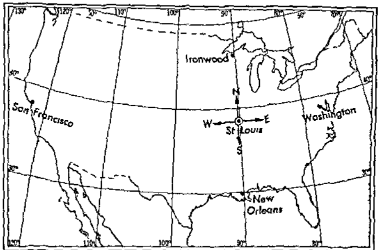


Here you might guess at first glance that Capetown is south of Stockholm. But what is the direction between Novosibirsk and Benares? You can tell by checking against meridians of longitude. Stockholm and Capetown are near the meridian for 20° east of Greenwich. The others are near the meridian for 80° east. In both instances the direction is north and south.



What American cities are east, west, north and south of St. Louis? One city in each direction is shown on the map at the top of the next page. They can be located by tracing parallels of latitude and meridians of longitude.

Finding Directions on Three Kinds of Maps



The map above shows St Louis and cities east, west north, and south of St Louis These directions may not be plain but you can trace them easily by following the parallels and meridians *St Louis, Washington and San Francisco are all near the parallel for 40° north* latitude St Louis, New Orleans, and Ironwood are near the meridian for 90° west longitude The curved parallels and meridians show that the map is a polyconic projection.

and south correctly In the same way, parallels of latitude always show east and west correctly

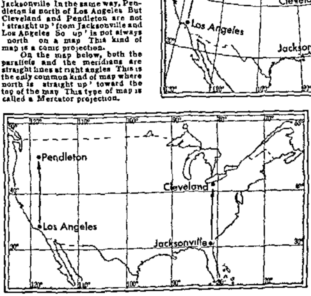
The pictures on the opposite page show simple examples of finding directions on a globe In each one the places lie east and west or north and south of each other But you can use parallels and meridians to find other directions If place A is both south and east of place B find the nearest meridian and parallel to each one Then measure the east-west distance along a parallel and the north-south distance along a meridian Draw these on paper Put each place at the right space from its parallel and meridian Then connect the two places Lay the parallel of your drawing east and west across the middle of a compass Then read the direction of the line joining the two places It will be roughly correct, unless you have crossed a pole

For accurate directions you must find a great circle course This can only be done by difficult calculations, except with a special kind of map called a gnomonic projection (For an explanation of great circle courses, see the article Navigation For the gnomonic projection, see the article Maps)

Two Contrasting Maps

On the map at the right the parallels are curved and the meridians are straight The meridians north and south show directions truly Follow the meridian north from Jacksonville You will come to Cleveland So Cleveland is north of Jacksonville In the same way, Pendleton is north of Los Angeles But Cleveland and Pendleton are not "straight up" from Jacksonville and Los Angeles So "up" is not always "north" on a map This kind of map is a conic projection.

On the map below, both the parallels and the meridians are straight lines at right angles This is the only common kind of map where north is "straight up" toward the top of the map This type of map is called a Mercator projection.



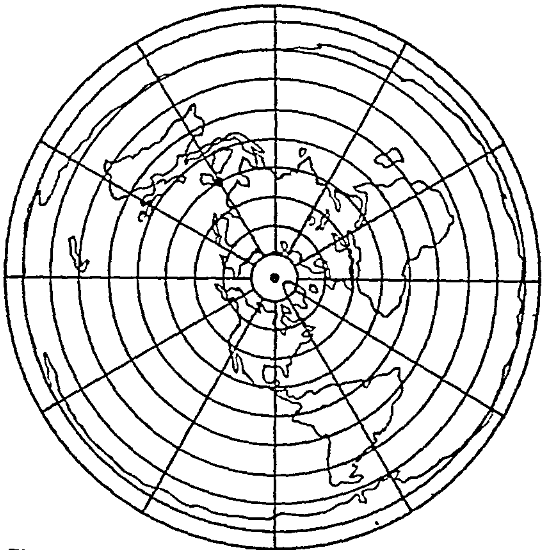
Finding Directions on Maps

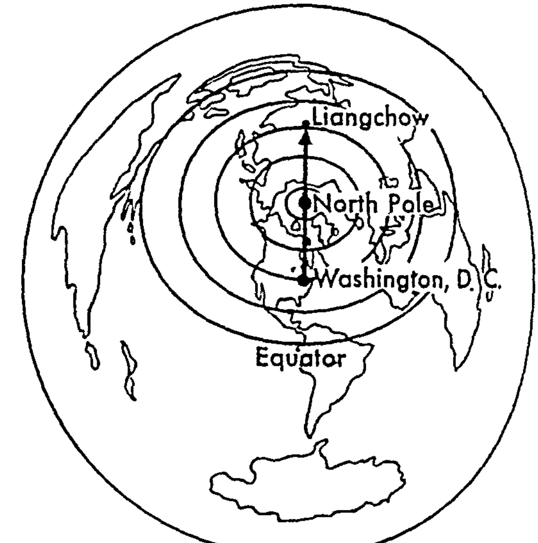
To find directions on maps, the best rule is to use the parallels and meridians just as you did on the globe Many people think they do not have to do this They think that "up" on a map (toward the top) is north, "down" is south, and "left" and "right" are east and west But usually this idea is wrong, especially if the map shows an area as large as the United States or North America The three maps on this page show why

All maps are flat But they must show the curved surface of the earth as best they can To do this, many maps show the parallels and the meridians somewhat as you would see them if you were looking from a distance at the region on a globe

If you look at the United States on a globe, you will see the meridians drawing together toward the north Toward the east and west edges of the map you will see the parallels curving upward

Directions on Some Special Kinds of Maps





The map at the left, called a *polar projection*, is drawn around the North Pole. So the lines running out from the pole all run south. The circles are the east-west parallels of latitude. Notice also how the map shows the southern half of the earth. You could not see this half if you looked down on the North Pole on a globe. But the map shows it by continuing the south-pointing lines and stretching the southern lands around them. The South Pole is stretched into a circle around the edge of the map. The second map shows the world arranged around Washington, D. C., as a center. It is an *azimuthal equidistant projection*. Notice that the short line from the United States to Liangchow in China starts north then changes, pointing south as it passes the pole. This suggests that the right way to read the direction between these places is east or west along a parallel of latitude.

Most kinds of maps imitate this appearance in some way. In the maps on the previous page, the first one uses curved meridians and curved parallels. The second map uses straight meridians and curved parallels. But neither map shows "north" as "up" and so on. The directions go where the meridians and parallels go.

The third map has straight meridians and parallels. And "up" is "north." This is a special map called a Mercator projection. It shows sailors and aviators their directions from place to place and it does this accurately. But it gives a false idea of the earth's surface. And the strange thing is that the idea is false *because* the north-south lines run straight up and down.

Notice how these lines run on a globe. They all come together in two points, the North and South Poles. They should do this on a map if the map includes the poles. On the first two maps they would meet at the North Pole if the maps reached that far. But on the Mercator map the lines all run straight up. So *every place* on the top line would be the North Pole. The map maker has "stretched out" the pole, which is actually a *point* on the earth or a globe, into a line as wide as the map.

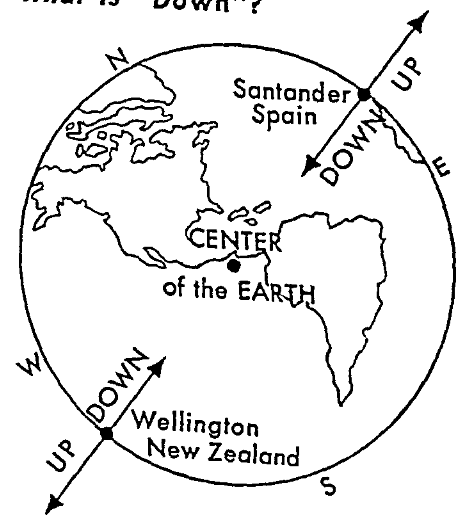
Canada and other northern lands have also been stretched out badly. You can see this by comparing Canada on the map with Canada on the globe. So the Mercator map is good for directions but not for showing land, especially northern or southern land.

Using Polar or "Air-Age" Maps

Knowing how to tell direction from meridians and parallels is especially important for using polar maps. Because of their special qualities, polar maps are sometimes called "air-age" maps. Instead of having north at the top and south at the bottom of the map, it has the North or South Pole in the center. This kind of map is called a *polar projection*. The map at the top of this page (left) shows how it looks. The meridians run out from the pole like the spokes of a wheel, and the parallels of latitude go around in circles. Remembering this makes it easy to find directions on such a map.

This map has the North Pole in the center. At any

What Is "Up" and What Is "Down"?



This globe shows the true meaning of "up" and "down." "Up" is away from the center of the earth, deep within the globe; "down" is toward the center. They are not parallel to the earth's surface. They run oppositely for two persons on opposite sides of the earth in Spain and New Zealand if we view them from space. To both persons, however, "down" feels the same. Both feel the pull of earth's gravity.

place on it, north is toward the pole and south is away from the pole The direction can be judged from the nearest meridian East and west can be judged from the *nearest parallel of latitude* An illustration with the South Pole at the center can be seen in the article Antarctic Continent

Another type of "air age' map has a place other than one of the poles at the center On the opposite page is a map with Washington, D C, as the center As you can see the grid of meridians and parallels is peculiar looking When you can figure out directions on a map of this type, you really know about directions But you can do so if you remember the rule To find any place on a map always judge directions from the nearest meridian and parallel (For more information about maps and how they are drawn, *see* Maps)

What Is "Up" and What Is "Down"?

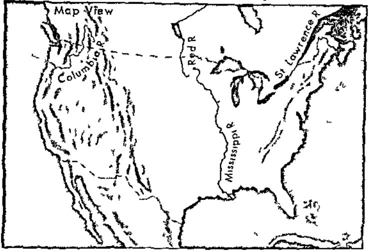
These maps have shown us that the meridians can keep us from mistaking "up" for north and 'down" for south An even better way to avoid confusion is to know what we really mean by up" and "down"

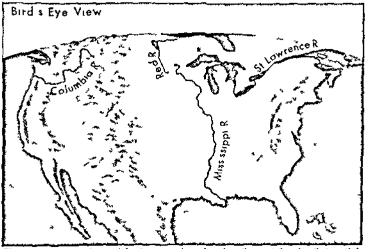
We all have some idea of what the words mean When we are standing, our feet are 'down and our heads are "up' 'Down' is also the way an object falls if it is let loose in the air And we dig "down" if we want to dig a hole into the earth

All these facts suggest the true meaning of 'down' It is always the direction *toward the center of the earth* Everything on the earth is always drawn in that direction by the force of gravity. Wherever we are on the earth we always feel this pull So we never have any doubt about which way is "down."

We can understand too that the rule is the same everywhere on the earth Failure to understand this has caused many mistakes In the days when Columbus discovered America, the force of gravity was not understood, and many people wondered about conditions on 'the other side of the earth.' Many of them wondered why people "on the other side' did not fall off into the sky They even wondered if the others might have to stand on their heads

How Can Rivers Flow "Up" on a Map?





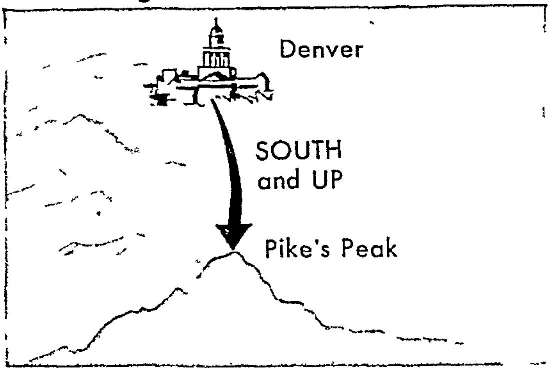
These pictures correct a mistake many people make when they get the idea that north is also 'up' They wonder how rivers like the *St Lawrence* and the *Red River of the North* can flow up But the lower view shows that all the rivers on the map are flowing *down* *The Mississippi* the St Lawrence, and the Red River flow downward from the plateau region around the Great Lakes the Columbia starts down from the high Canadian Rockies. North and south have nothing to do with the direction of flow

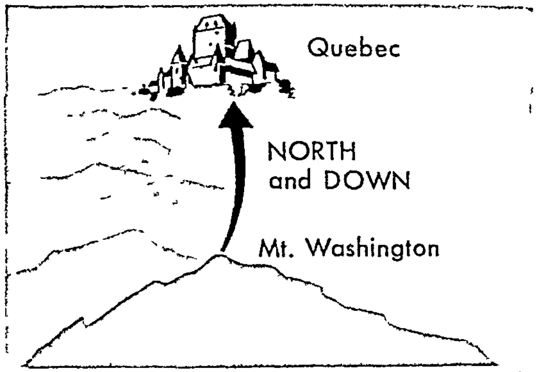
Today we know that "up" and "down" are the same everywhere The earth revolves once in every 24 hours And every moment of that time our feet are held firmly "down" toward the center of the earth by the force of gravity

Knowing this rule also prevents mistakes of the kind many people make because they confuse "north' and 'up' These mistakes are common because map makers usually place north toward the top of the map Then north looks 'up' if we see the map in a book or hung on a wall. This is what causes the mistakes

People look at a river that flows north and wonder how it can flow up The map above shows two rivers

Combining North or South and "Up" or "Down"





These pictures show that a compass direction like south or north can be combined with an up or down direction. In each example, the combination of the two directions is the opposite in result of the common expressions "down south" or "up north." So we see that these expressions do not indicate any real relation between compass directions and up and down; they are simply a manner of speaking

and how they flow. People also say that Florida is *down* south from Ohio, and Canada is *up* north from the United States.

Actually "up" and "down" have nothing to do with north and south. The last two directions are fixed by the poles of the earth. Up and down are fixed by distance from the center of the earth. We often go south and up or north and down. The pictures above show two common examples of such motion.

Finally, we can understand directions that slant up or down. The pictures below show one example. We have another when we point *north* and *up* at the North Star. We can understand these slanting directions by dividing them into an up-or-down part and a direction along the surface of the earth.

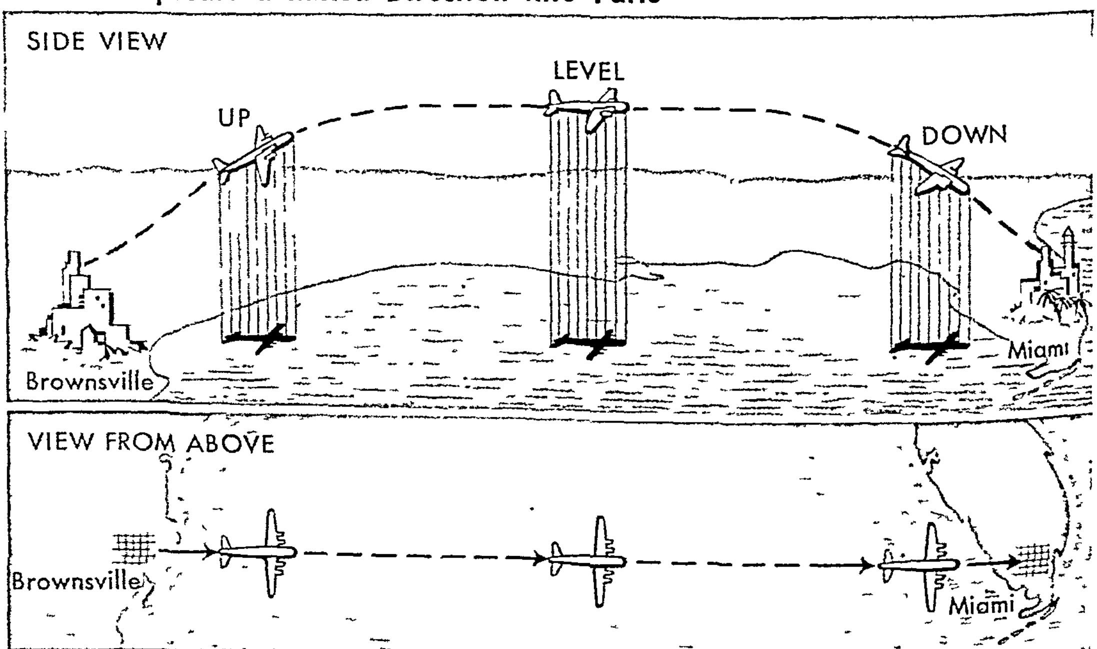
Directions in Outer Space

For a final test in understanding directions, we can imagine ourselves going to the moon on a space ship. Soon the earth would just be a large ball behind us, and we would be floating beneath the stars. Then we would lose all sense of directions.

An astronomer might feel at home. He could still think of the North Star as "north." But there would be no other directions as we know them.

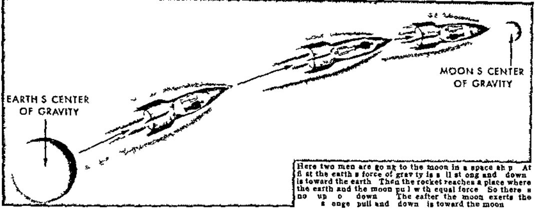
Stranger things would happen to our ideas of "up and down." On the earth these are fixed for us by

We Can Separate a Mixed Direction into Parts



If an airplane is going up or down, can it be going in some other direction as well? These pictures show that it can. The plane goes up from Brownsville, Tex., flies east on a level course, then goes down at Miami, Fla. But all the while its *shadow* is going east. The view from above the plane also shows this motion. So the plane's motion can be separated into an up-or-down part (called the *vertical component*) and a direction along the ground (the horizontal component).

What about "Up" and "Down" on a Trip to the Moon?



Here two men are go ng to the moon in a space sh p At fi st the earth s force of grav ty is s ll st ong and down is toward the earth Then the rocket reaches a place where the earth and the moon pu l w th equal force So there s no up o down The eafter the moon exerts the s onge pull and down is toward the moon

the force of gravity Down is where we would fall if not supported It is where we put our feet to hold us up

Near the earth we would st ll feel its pull So we would keep our feet toward the earth But as we go ahead the force of gravity from the moon would be getting stronger In time it would be equal to the force exerted by the earth Then there would be no pull either from the earth or the moon As far as these two celestial bod es are concerned we would just float inside the ship

Our ship and our bod es would have their own cen ter of gravity and we would be drawn toward it With only this attraction considered we could stand comfortably feet to feet in the center of the sh ip Of course there would also be a pull from the sun So we would also feel a tendency to put our feet down toward the sun

Then as we keep going the moon would exert stronger pull Soon we would want to put our feet down toward the moon So we would stand with our feet toward the nose of the sh p instead of the tail

All these ideas are strange and perhaps puzzling But progress with rockets and jet propuls on suggest that space ships may not be far away If we can im agine the difference in gravitational pull and other factors in a rocket ship we will have a much clearer understanding of directions on earth

DISEASES *and How* MAN FIGHTS *Them*

DISEASE In 1793 an epidemic of yellow fever killed more than one-e ghth of the people in Ph ladelphia Five years later in the same city one-tenth died of the same disease In 1832 a cholera ep demic killed more than one-tenth of the citizens of New Orleans Until the last hundred years epi demics like these were common

The mysteriousness of epidemics added to the r ter ror No one knew what caused them—why they be gan and why they finally died away People dreaded them more than they dreaded war

Today serious widespread ep demics are rare in civilized countries Science has removed the mystery from the worst epidemic diseases In doing so it has found ways to control them

The conquest of deadly epidemics is a triumph of scientific progress But it is only one step forward in man s conquest of disease Since epidemics have been controlled people live longer Other types of disease have become more important The goal of conquering these has repla ed the earlier goal of con trolling epidemics The fight against disease con t nues, and each year science scores new victories

We can understand both the fight and the victories better if we understand the underlying causes of dis ease We need to know too how the body itself fights disease It has wonderful means of defense and recovery Taking advantage of these is often the best way to prevent or cure illness

What Caused Epidemics?

We know today that epidemic diseases are caused by small organisms such as bacteria that are pres ent in air water and soil They may be breathed into the body in air They may enter in food or wa ter Insects carry many of them from person to per son or from animals to man Once we understand the cause of the diseases we can understand why they spread so rap dly For example if a c ty s water sup ply was polluted every one in the city was exposed to attack by organisms that spread in water

Invading organisms cause many other diseases bes des those that produced the great epidemics Together these diseases make up the classification known as *infectious diseases* These are the ones we know most about today and the ones over which we have the most control

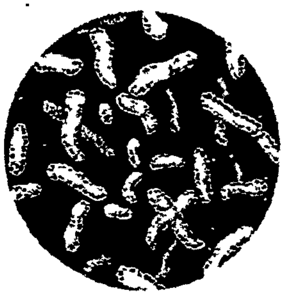
How Organisms Cause Disease

The disease-producing organisms are true parasites After they have entered the body they live there at the body s expense As they live and multiply they

THESE GERMS CAN CAUSE DEADLY DISEASES

These rod-shaped bacteria cause typhoid fever. The threadlike flagella help them to move about.

Sanitary control of drinking water conquers these cholera germs. They are spiral-shaped bacteria.



These diphtheria bacilli were once a leading cause of death. Today antitoxin gives protection against them.

Tsetse flies inject these protozoa (trypanosomes) into man's blood, causing African sleeping sickness.

AGENTS THAT CAUSE INFECTIOUS DISEASE

The following list groups the principal infectious diseases according to the kind of agent that causes them:

Bacteria: anthrax, bacillary dysentery, bubonic plague, cholera, diphtheria, erysipelas, leprosy, meningitis, paratyphoid fever, pneumonia, rabbit fever (tularemia), scarlet fever, tetanus, tonsillitis, tuberculosis, typhoid fever, undulant fever (brucellosis), and whooping cough.

Virus: chicken pox, common cold, German measles (rubella), infantile paralysis (poliomyelitis), influenza, measles, mumps, parrot fever (psittacosis), rabies, shingles (herpes zoster), sleeping sickness (epidemic encephalitis), smallpox, virus pneumonia, and yellow fever.

Protozoa: African sleeping sickness, amoebic dysentery, kala-azar, malaria and yaws.

Rickettsia: typhus fever, Rocky Mountain spotted fever, and trench fever.

Fungus: athlete's foot (dermatophytosis), ringworm of the scalp (tinea capitis), and fungus infection of the ear, nose, or other part of the body.

irritate, change, and destroy surrounding cells and tissue. Even worse, they manufacture poisonous substances which enter the blood stream and travel to various parts of the body. These poisons are called *toxins*. The sum total of the damage the organisms cause is called *infection*.

Some disease-producing organisms are one celled plants—bacteria or fungi. Others are one-celled animals—protozoa. Still others are more difficult to classify. *Rickettsiae* are plantlike bodies similar to bacteria. *Viruses* have certain characteristics of living organisms, but some of them, at least, are actually molecules of protein (*see* Virus).

Infection-producing agents are all extremely small. Most of them can be seen only with the help of a microscope. Viruses are invisible even with a high-powered microscope, but some have been seen with an electron microscope (*see* Microscope). Because they are extremely small, these various disease producing agents are known as microorganisms. Popular names that have been given to them are "germs" and "microbes."

Organisms that produce infection may enter the body through the nose and throat. They do so in most of the infectious diseases of childhood, including scarlet fever, diphtheria, mumps, measles, German measles, and whooping cough. They enter through this route, too, to cause the common cold and influenza. Usually the microorganisms are spread in droplets of moisture coughed or sneezed into the air by infected people and breathed in by others. They may pass from infected to uninfected persons on contaminated clothing or eating utensils, or even from hand to hand. Diseases that are communicated in these and similar ways are called *contagious diseases*.

Among organisms that enter the body in contaminated food are those of undulant fever. The bacteria that cause this disease enter the digestive tract of human beings in milk from infected cows. In typhoid and paratyphoid fever, water as well as food may be the carrying agent. The germs of cholera spread in polluted drinking water.

In many infectious diseases the infecting organism enters through the skin. The bacillus that causes tetanus is an example. It is present in soil and goes into wounds along with dirt. Insect carriers (called *vectors*) deposit many organisms on the surface of the skin or in bites. Scratching then forces the organisms deeper into the tissues. Lice, ticks, and fleas carry Rickettsia. Bubonic plague is actually a disease of rats. Fleas that live on rats carry the plague bacteria to human beings. Mosquitoes carry the protozoa that cause malaria and the virus of yellow fever. Since mosquitoes are bloodsucking insects, they deposit the germs directly in the blood stream (*see* Mosquito).

The Human Body Defends Itself

The first protection the body has against germs is the outer layer of skin (the *epithelium*). This is a layer of protective cells which covers the true skin and the mucous membranes. Most bacteria and other infectious agents are harmless unless they can penetrate this layer. Helping the epithelium to defend the body against invasion are secretions such as tears, sweat, and mucus. Irritation stimulates their flow, and they serve to carry off invading organisms.

The secretions of the stomach are acid enough to kill many such organisms and destroy their toxins. Vomiting, coughing and sneezing are all means of getting rid of harmful invaders.

If microbes pass the first line of defense, cells called *phagocytes* meet their attack. These cells engulf and destroy germs in a process known as *phagocytosis*. Some white blood cells (leucocytes) are phagocytes (*see* Blood). They carry on phagocytosis in the blood when organisms get into the blood stream. When germs attack a certain area, as in tonsillitis, they move through the walls of capillaries in that area to attack the invaders. In this case *macrophages* help them. These are large, amoebalike phagocytes formed by many body tissues. They move through the body toward any infected area as if they had received a call for help. Phagocytes of a third kind cannot move. Some, located in the lymph nodes, destroy bacteria that become trapped there (*see* Blood). Others, lining the blood passages of the liver, spleen, and bone marrow, capture and kill bacteria that enter these organs in the blood.

The Fighting Antibodies

The leucocytes and macrophages have vigorous allies in certain substances the tissues makes to fight infection. These substances are antibodies. Little is known about their chemical composition or about how the body manufactures them. But their action is fairly well understood. They begin to appear in the blood soon after germs invade the body. Some antibodies stimulate phagocytosis. Others make the invading organisms clump together. Then they cannot travel so easily through the body and are more likely to be caught in the lymph nodes. Still other antibodies, known as antitoxins, act as an antidote for the poisons the germs generate (*see* Antitoxins).

The battle between antibodies on one side and the invading germs and their poisons on the other becomes the battle between the patient and his disease. If his body cannot make antibodies fast enough, the germs win and he dies. If his body produces enough antibodies quickly enough, he recovers. In this case antibodies remain in his blood. They stay permanently after some diseases, including scarlet fever and measles, and for various periods after other diseases. As long as they remain, the person is immune to, or safe from, that particular disease.

How Science Conquers Epidemics

The first great victory in science's conquest of epidemics occurred in 1796. In that year Edward Jenner of England performed the first vaccination for smallpox (*see* Vaccination). Vaccination gradually put an end to one of the world's worst scourges, the smallpox epidemic. Sixty million people are believed to have died of smallpox in the 18th century. Today, because of vaccination, the disease is rare.

THESE SPRAY GUNS KILL TYPHUS CARRIERS

Here Japanese health officials are spraying the heads of school children with DDT (dichlorodiphenyl trichloroethane) to check an epidemic of head lice. Control of lice is extremely important. Body lice may carry the germs of typhus and create epidemics of this dread disease.

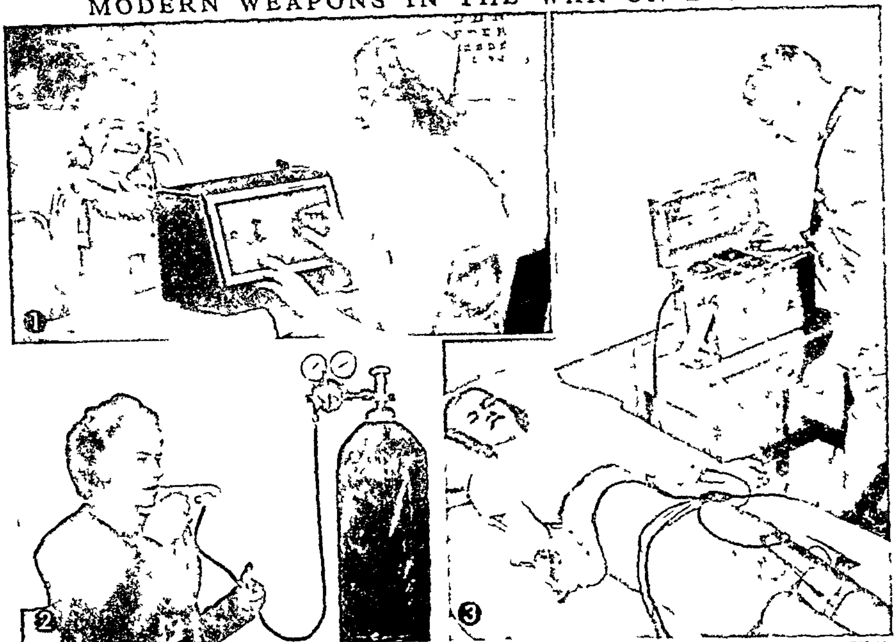
But Jenner's invention of vaccination did little to clear away the mystery of epidemic diseases. No one really understood why vaccination was successful in preventing smallpox. No one knew yet what caused the diseases that spread from person to person with terrifying rapidity. A few people had seen bacteria and protozoa through the early crude microscopes, but they did not associate these tiny creatures with disease.

In the 1850's Louis Pasteur, the great French chemist, demonstrated that microscopic particles from air caused the souring of milk and other types of fermentation. He became convinced that these particles were "germs of life" and that they caused fermentation by reproducing themselves. This was a revolutionary idea, because the scientists of Pasteur's day believed that the minute organisms they saw through the microscope were spontaneously generated.

Pasteur's work led directly to the germ theory of disease, that organisms present everywhere in air cause infection by getting into the body and multiplying there. In 1876 Robert Koch, a German doctor, isolated the bacillus that causes anthrax, a disease of cattle. He raised several generations of the germs in broth until he had a pure culture, free from other germs. Then he injected the culture into mice and rabbits, and these animals developed anthrax. This was the first proof that a particular germ caused a particular disease.

Discoveries then followed one another rapidly. Pasteur isolated the germ of chicken cholera in 1880 and devised a vaccine for the disease. A year later he successfully vaccinated cattle against anthrax. In 1885 he perfected a vaccine for the prevention and treatment of hydrophobia, the terrible disease caused in human beings by a virus from the saliva of dogs with rabies. Koch identified the bacillus of

MODERN WEAPONS IN THE WAR ON DISEASE



1 The audiometer produces regulated tone signals that make accurate hearing tests possible. 2 With this apparatus, called a nebulizer, the patient breathes a mist of germ-killing penicillin into infected air passages. 3 The electrocardiograph registers from the surface of the body the electric charges generated by the heartbeat. It writes them down as a series of waves on the paper shown rolling out of the cabinet. The shape of the waves tells the doctor whether or not the heartbeat is normal.

tuberculosis in 1882 and the germ that causes cholera in human beings in 1883.

Progress has been steady since the days of these great pioneers. Once medical scientists knew that germs cause disease, they could learn how the germs spread and so develop means of control. The measures we take for granted today gradually came into use: quarantining of patients with contagious diseases; use of antiseptics in hospitals and sick rooms; sterilization of surgeons' instruments; use of antiseptics in wounds; purification of water supplies; control of mosquitoes, rats, and other germ carriers.

Scientists have identified one by one the germs of most infectious diseases. They have developed vaccines and serums to prevent and treat many of them (*see* Serum Therapy). They have created powerful drugs—including the sulfa drugs, penicillin, and streptomycin—that kill germs in the body without harming the body itself (*see* Antiseptics).

Victories Still to Be Won

Not all the infectious diseases have been conquered. The common cold is an ever-present enemy. A virus is accepted as its cause. The virus is known to spread in droplets of moisture coughed or sneezed into the air or passed from person to person on contaminated drinking cups, towels, and so on. But no one has found a really effective vaccine to prevent colds or a specific treatment for them.

Rheumatic fever causes more deaths among children from 5 to 14 than any other disease. Infection permanently damages the hearts of many who survive it. Scientists have not identified the organism that causes this disease, and they do not know how it spreads. Infantile paralysis (poliomyelitis) is another unconquered enemy. In some years it strikes as many as 25,000 people in the United States. The cause is known to be a virus that attacks the cells of the central nervous system. But no way to control this virus has been found.

The infectious diseases whose mysteries remain unsolved are a challenge to medical scientists everywhere. Each year brings new victories in the fight against them. In view of the progress since Pasteur's day, it seems certain that eventually all of them will be conquered.

In the meantime, medical science has been active in many other directions. As the most deadly of the infectious diseases have been brought under control, diseases due to other causes than germs have become more important. Some of the victories scored against these diseases have been almost as spectacular as those won against the epidemic diseases.

Diet May Mean Health or Disease

In 1795, when the British Navy ordered all sailors to be given rations of lime juice, no one recognized this as a step toward control of a group of often fatal diseases. Sailors had known for a long time that scurvy, which killed so many of them on long sea voyages, could be prevented or cured by fresh vegetables and fruit, particularly limes and lemons. But neither they nor the doctors who treated them knew why this was so. Today we know that lack of vitamin C in the diet is the cause of scurvy, and that vitamin C is plentiful in many fresh vegetables and fruits.

Scurvy is one of a group of diseases known as the *deficiency* diseases because it is due to a deficiency of an important food element in the diet. Other diseases in this group are rickets, beriberi, pellagra, and various minor disorders. The story of their identification and control has been for the most part the story of the vitamins (*see* Vitamins).

Another kind of disease is caused by inefficient functioning of the endocrine glands. These glands manufacture hormones: substances which regulate various activities of the body. A gland may make too much or too little of its hormone. If it makes too much, as in some cases of goiter, a surgeon may be able to re-

move part of the gland If it makes too little the missing hormone may be supplied by an extract made from the glands of animals One of the great victories of medical science was the conquest of diabetes a disease due to a deficiency in the pancreas with insulin extracted from the pancreas of animals (see Hormones)

Allergy or sensitivity to various substances causes many diseases These usually are not fatal but they cause much suffering (*see* Allergy)

Some diseases are due to the fact that a part of the body did not develop normally before birth An example is the condition that causes some babies to be known as blue babies These children are born with a defect of the heart or large blood vessels which interferes with the flow of blood to the lungs (*see* Heart) As a result their blood never gets enough oxygen About 1945 an operation was devised that has meant life and health to many blue babies In this operation the surgeon creates an arterial duct to allow more blood to flow into one lung

Wayward Cells

Probably the most dreaded disease today is cancer To the biologist this disease is a fascinating mystery of life and growth All human beings begin life as a single cell and develop into a complicated but well-organized association of cells Occasionally and no one knows why several cells turn traitor They begin to multiply antisocially—outside the body's cellular organization This produces an alien parasitic growth at the expense of the normal cells

The growth may become a *benign* tumor or cyst If it does it is easily removed and is not likely to return Or it may become a cancer This is a *malignant* growth Unless it is removed early by surgery or irradiation it invades the tissues so extensively that it cannot all be removed In such cases it recurs and eventually reaches a vital spot

Sometimes white blood cells begin to multiply without any known stimulus In time the wayward white cells overrun the red cells and the normal white cells This disease is known as leukemia from Greek words meaning white blood

Cancer is second among causes of death in the United States today In 1900 it was tenth In view of this increase Congress has authorized a broad program to fight the disease both by educational measures to encourage early recognition and by research into causes and remedies In 1948-49 it appropriated $22 000 000 to carry out the program of the National Cancer Institute

Diseases That Come with Age

The first and third causes of death in the United States today are heart disease and hemorrhage of the brain (cerebral hemorrhage commonly called a stroke or apoplexy) In 1900 heart disease was fourth on the list and hemorrhage of the brain was eighth

Heart disease as a cause of death is most often due to hardening of the arteries or high blood pressure (see Heart) Hemorrhage of the brain is due to hardening of the arteries Doctors do not know the underlying cause of either hardening of the arteries or high blood pressure but both of these conditions usually occur late in life Their present high incidence seems to be due to the fact that people live longer than they used to and so are more susceptible to diseases that occur with age.

DISRAELI (*dĭz-rā lĭ*) BENJAMIN EARL OF BEACONSFIELD (1804-1881) A clever novelist and a brilliant statesman were combined in Benjamin Disraeli He rose to leadership of the Conservative (formerly Tory) party in Great Britain and twice he held the position of prime minister

In his early years Disraeli was handicapped by the fact that though a Christian himself he was the son of Jewish parents He needlessly handicapped him self further by his foppish dress and theatrical manner The first time he tried to make a speech in the House of Commons ridicule forced him to give up But before he did so he shouted I shall sit down now but the time is coming when you will hear me

Disraeli worked hard to make this prophecy come true and before his death his speeches were anxiously awaited The debates between him and his great rival Gladstone leader of the Whig (Liberal) party were some of the keenest that had ever been held in the House of Commons Disraeli was noted for his wit In 1846 when Sir Robert Peel the Tory (Conservative) leader abandoned the position of his party and advocated the repeal of the Corn Laws—a Whig measure—Disraeli declared that Peel had caught the Whigs bathing and had walked off with their clothes

Finally Disraeli became the leader of the Conservatives in the House of Commons Under his leadership the Conservatives no longer opposed all progressive measures In 1867 he persuaded them to dish the Whigs by carrying through a Parliamentary Reform Bill extending the right to vote even further than the Whigs had suggested

In 1868 Disraeli realized the wild ambition of his first years in Parliament He became prime minister as head of the Conservative party His ministry fell within a year but in 1874 he was again called to the premiership This time he remained in office six years As premier he was much more acceptable to Queen Victoria than was Gladstone Disraeli was the founder of modern British imperialism He purchased for Britain from the bankrupt Khedive of Egypt his shares in the Suez Canal and so safeguarded England s route to India In 1876 he had Queen Victoria proclaimed Empress of India He played a clever part against Russia in the Congress of Berlin (18"8) blocking its progress in the Balkans and saving Turkey Returning to London he claimed that he had brought back peace with honor The Queen rewarded him with the title Earl of Beaconsfield and a seat in the House of Lords In 1880 the Conservatives were defeated and he retired He died the next year

Disraeli s success as a writer was due largely to his political experience He was the first successful author of political novels Some of his best-known writings are Vivian Grey (1826) Henrietta Temple (1837) Coningsby (1844) Sybil (1845) Tancred (1847) Lothair (1880)

DISTILLATION. In many parts of the world the only sure way of getting pure drinking water is by the process called distillation. This consists simply of catching the steam from boiling water and cooling it until it turns back to liquid form. Water so obtained is pure, for rising steam does not carry any of the solid impurities from the original water.

Any liquid, if it gets hot enough, will boil and give off vapor, which may be cooled and condensed in the same way as steam; hence distillation finds many other important uses. Chief of these is the process called "fractional distillation" employed in producing, among other things, gasoline and kerosene from crude petroleum, in making alcohol, perfumes, etc.

This process rests upon the principle that different substances will boil at different degrees of heat. If you heat a mixture of water and glycerin, for example, the water will begin to turn to steam long before the glycerin gets hot enough to give off its vapor. By keeping the temperature high enough to vaporize the water, but not high enough to vaporize the glycerin, you can collect and condense the water vapor, leaving the glycerin behind. In the same way, when petroleum is heated the gasoline will come away before the kerosene does. (*See also* Petroleum, subhead "Cracking Petroleum Cuts into Gasoline.")

DIVING. Generally speaking there are two types of diving—deep sea and shallow water. In the latter, direct ascents may be made to the surface from depths of about 36 feet. Deep-sea diving, however, requires stops at intervals on the way to the surface to equalize water and air pressures. Water pressure increases $4\frac{1}{3}$ pounds per square inch for each ten feet of depth. As a diver slowly descends the pressures of water and air are equalized and more and more air is absorbed into the body tissues. The ascent, therefore, must be made in stages to allow slow decompression; otherwise the gas pressure within the body causes the formation of nitrogen bubbles which block the blood vessels. In this condition, called the "bends," the diver has convulsions. (*See also* Caisson; Helium.)

The deepest open-sea dive known, 535 feet, was made off the coast of Scotland in 1948. A special suit was used which equalized internal and external air pressures. The United States Navy records the deepest simulated dive, in a pressure tank, as 561 feet. A newer device, called the aqualung, has been developed for individual pressure diving. (For description of this apparatus, *see* Aqualung in Fact-Index.) The bathysphere, benthoscope, and bathyscaphe are more elaborate submarine devices developed to explore far greater ocean depths (*see* Ocean; Beebe).

Perhaps the most interesting work of the diver is the salvaging of treasure. Nearly 25 million dollars in gold bars were recovered in this way from the hull of the *Laurentic*, a British vessel sunk off the Irish coast during World War I.

In the construction of bridges, dams, underriver tunnels, waterworks, etc., divers survey for foundations, caissons, and pile settings. Waterworks in large cities keep a diver employed constantly. The United States Navy trains divers in huge steel-pressure tanks, thus artificially reproducing deep-water conditions, and employs many to set submarine mines, locate lost torpedoes, and examine ships' bottoms. Deep-sea divers are also used in several industries, as in fishing for pearls, corals, sponges, and shells. The darkskinned swimmers of the tropics often perform such work without any equipment, and some of them can dive to great depths and remain under water two or more minutes.

WHERE STUDENTS LEARN TO STAY AT THE BOTTOM

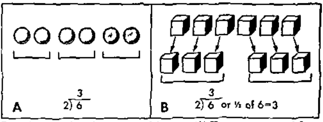
Two students at the Navy's deep-sea diving school in Washington, D. C., exhibit the 200-pound diving suits in which they are about to be lowered by stout lifelines to the bottom of the Anacostia River. Notice the huge lead shoes worn by the diver at the left. They weigh 17½ pounds each.

Diving dress or armor may be of metal or rubber. Perhaps the most efficient suit is one of aluminum alloy, weighing about 500 pounds. The helmet is usually of copper, with windows covered with thick glass. Leaden weights are attached to enable the diver to descend rapidly. The shoes have lead soles to enable him to keep his balance, feet down. Divers communicate with fellow workers on the ocean bottom and with attendants above by cords, speaking tubes, or telephonic apparatus. Air is supplied from a pump above through a flexible tube entering the helmet. The poisonous breathed air escapes through another tube leading out from the back of the helmet or through a valve arrangement.

Some suits are "self contained" making the diver independent of any connection with persons above water. In one such suit a compressed air reservoir on the diver's back supplies him with air by a self regulating apparatus. When he wishes to ascend he simply inflates his dress from the reservoir. In another form the air breathed is filtered and regenerated by means of an oxygen helmet. The oldest successful diving apparatus still occasionally used is the diving bell, a big iron cylinder closed at the top and open at the bottom. When this is lowered into the water the air in it keeps the water out. Fresh air is pumped in from above and a special arrangement allows the foul air to escape.

DIVISION—*A Basic* ARITHMETIC SKILL

DIVISION The diagrams at the right show two different uses or meanings of the process of division. Diagram A shows the meaning of the problem: How many times can you take a group of 2 balls out of a group of 6 balls? We could also get the answer by finding how many times we can subtract 2 from 6.



These diagrams show the two uses of division. (A) How many groups of 2 can be taken out of 6? (B) What is the size of 2 equal groups in 6?

In diagram B we see 6 blocks separated into 2 equal groups. The sorting was done by moving the six blocks one at a time into two piles. This diagram shows the meaning of the problem: If we divide 6 blocks into 2 equal groups how many blocks will there be in each group? Or how many blocks are there in one half of 6 blocks?

The work above shows that we should divide to find the answer when we wish either to find how often a given number can be taken out of another number or when we wish to separate a number into equal parts and find the number in each part.

It can be seen that subtraction and division are related processes since both involve separating or taking apart. For example to find the answer to the example 20)87, we can subtract 20 from 80 four times leaving a remainder of 7. We express the answer as 4 r 7 or as 4 $\frac{7}{20}$.

Steps in Working an Easy Division Example

The example 3)78 requires division by a one-place number 3. To work this example two division facts must be known: (1) the uneven division fact 3)7 and (2) the even division fact 3)18. The series of steps taken in working the example are as follows:

```
  26
3)78
  6x
  18
  18
```

Think of 78 as 7 tens and 8 ones.

a. *Divide* the 7 tens by 3. 3)7 is 2 and a remainder. Write 2 in tens place in the quotient because we are dividing tens.

b. *Multiply* the 2 tens by 3. Write 6 under the 7 tens in 78. (The x is a space holder.)

c. *Subtract* 6 from 7. Write the remainder 1 ten. Compare it with the divisor 3. The remainder must be less than the divisor.

d. *Bring down* the 8 ones making in all 18 ones.

e. *Divide* the 18 ones by 3. 3)18 is 6. Write 6 in ones place in the quotient.

f. *Multiply* the 6 ones by 3. Write 18 under the 18 ones. There is no remainder.

It can be seen that working this easy division example is a rather complicated process in which we must group, divide, multiply and subtract. When we work examples in division by two-place numbers such as 25)76 we must also add correctly in carrying as when we multiply 25 by 3. Unless the child knows how to add, subtract and multiply correctly, and also knows the division facts, there will almost certainly be many incorrect answers in division. He must also know what division means and understand the series of steps in division. Division should be a meaningful series of operations.

```
   3 r 1
25)76
   75
    1
```

TERMS USED IN DIVISION

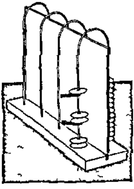
4 *Quotient* *Divisor* 9)36 *Dividend*	In 36÷9 the sign ÷ says 'divide'

Steps in Teaching the 90 Even Division Facts

There are 90 division facts having divisors from 1 to 9. The facts are grouped for study and practice in the chart on the next page. In arithmetic we do not use 0 as a divisor. In mathematics we learn that when any number is divided by 0 the quotient is *infinity*, an idea that should not be taught in the elementary school.

A MODERN COMPUTING ABACUS

Spacers separate the disks to show the division of 5 into 2 twos with a remainder of 1. The abacus is designed to visualize place value. It makes clear the regrouping step in subtraction and division and the carrying step in addition and multiplication.



The steps in teaching any division fact are as follows:

1. Present the fact in a social situation.
2. Have the children find the answer in ways that make the process meaningful, such as by grouping concrete objects.
3. Have the children make drawings of circles, crosses, and the like, showing the division fact.
4. Write the fact with numbers.
5. Show how the fact is related to multiplication. For example, $2\overline{)8}$ is 4 because $2\times4=8$.
6. Have each child make a study card for the fact.

The division facts should be taught in related groups. Thus all the division facts for 2 should be taught together. (See the second row in the chart on this page.) Use should be made of what has been learned about the multiplication facts for twos. Show, for example, that the three numbers at the right are used in four facts: $5\times2=10$, $2\times5=10$, $5\overline{)10}=2$, and $2\overline{)10}=5$.

2 **5** **10**

Teaching the Uneven Division Facts

There are 360 uneven division facts. The method of teaching the uneven division facts, such as $2\overline{)5}$, $3\overline{)20}$, and $6\overline{)51}$, is similar to that used in teaching the even division facts For example, to find the answer $2\overline{)5}$, the child should first use concrete materials to find the quotient and remainder. He might place 5 blocks on some surface, then take away groups of two blocks until only one block remains. This will show that $2\overline{)5}$ is 2 with a remainder of 1.

What has been learned about multiplication facts and the even division facts should also be used. For instance, to find the quotient and the remainder in $3\overline{)20}$, the pupil should think, "Because 3×6 is 18 and 3×7 is 21, the quotient of $3\overline{)20}$ must be 6; and there will be a remainder." He should first write 18 under the 20, then write 6 in the quotient; then he should multiply 3×6 to check the quotient; and finally, he should subtract 18 from 20 to find the remainder, 2.

$$\begin{array}{r} 6 \\ 3\overline{)20} \\ \underline{18} \\ 2 \end{array}$$

Dividing by Two-Place Numbers

The steps in the process of dividing by two-place divisors are the same as those given above for one-place divisors. The following series of examples shows the general grouping of steps that should be taught in estimating one-figure quotients. Within each group, the examples become increasingly difficult

Group I. Division by two-place numbers ending in 0
Examples: $10\overline{)40}$ $10\overline{)43}$ $20\overline{)60}$ $30\overline{)93}$ $40\overline{)72}$ $50\overline{)250}$ $60\overline{)367}$ $80\overline{)529}$

Division in these examples is almost like dividing by one-place numbers, since, as we have seen, we divide by the figure in tens' place to find the quotient. There are no ones to consider in the divisor.

HOW TO PRACTICE THE 90 EVEN DIVISION FACTS

$\overset{4}{1\overline{)4}}$	$\overset{2}{1\overline{)2}}$	$\overset{9}{1\overline{)9}}$	$\overset{5}{1\overline{)5}}$	$\overset{3}{1\overline{)3}}$	$\overset{1}{1\overline{)1}}$	$\overset{8}{1\overline{)8}}$	$\overset{0}{1\overline{)0}}$	$\overset{6}{1\overline{)6}}$	$\overset{7}{1\overline{)7}}$
$\overset{2}{2\overline{)4}}$	$\overset{8}{2\overline{)16}}$	$\overset{1}{2\overline{)2}}$	$\overset{5}{2\overline{)10}}$	$\overset{3}{2\overline{)6}}$	$\overset{6}{2\overline{)12}}$	$\overset{0}{2\overline{)0}}$	$\overset{9}{2\overline{)18}}$	$\overset{7}{2\overline{)14}}$	$\overset{4}{2\overline{)8}}$
$\overset{3}{3\overline{)9}}$	$\overset{8}{3\overline{)24}}$	$\overset{6}{3\overline{)18}}$	$\overset{0}{3\overline{)0}}$	$\overset{2}{3\overline{)6}}$	$\overset{9}{3\overline{)27}}$	$\overset{4}{3\overline{)12}}$	$\overset{7}{3\overline{)21}}$	$\overset{1}{3\overline{)3}}$	$\overset{5}{3\overline{)15}}$
$\overset{1}{4\overline{)4}}$	$\overset{6}{4\overline{)24}}$	$\overset{9}{4\overline{)36}}$	$\overset{5}{4\overline{)20}}$	$\overset{8}{4\overline{)32}}$	$\overset{2}{4\overline{)8}}$	$\overset{4}{4\overline{)16}}$	$\overset{7}{4\overline{)28}}$	$\overset{0}{4\overline{)0}}$	$\overset{3}{4\overline{)12}}$
$\overset{2}{5\overline{)10}}$	$\overset{7}{5\overline{)35}}$	$\overset{4}{5\overline{)20}}$	$\overset{9}{5\overline{)45}}$	$\overset{1}{5\overline{)5}}$	$\overset{6}{5\overline{)30}}$	$\overset{3}{5\overline{)15}}$	$\overset{5}{5\overline{)25}}$	$\overset{8}{5\overline{)40}}$	$\overset{0}{5\overline{)0}}$
$\overset{0}{6\overline{)0}}$	$\overset{5}{6\overline{)30}}$	$\overset{2}{6\overline{)12}}$	$\overset{4}{6\overline{)24}}$	$\overset{8}{6\overline{)48}}$	$\overset{3}{6\overline{)18}}$	$\overset{1}{6\overline{)6}}$	$\overset{6}{6\overline{)36}}$	$\overset{7}{6\overline{)42}}$	$\overset{9}{6\overline{)54}}$
$\overset{2}{7\overline{)14}}$	$\overset{6}{7\overline{)42}}$	$\overset{1}{7\overline{)7}}$	$\overset{5}{7\overline{)35}}$	$\overset{9}{7\overline{)63}}$	$\overset{0}{7\overline{)0}}$	$\overset{3}{7\overline{)21}}$	$\overset{8}{7\overline{)56}}$	$\overset{4}{7\overline{)28}}$	$\overset{7}{7\overline{)49}}$
$\overset{5}{8\overline{)40}}$	$\overset{3}{8\overline{)24}}$	$\overset{7}{8\overline{)56}}$	$\overset{2}{8\overline{)16}}$	$\overset{6}{8\overline{)48}}$	$\overset{1}{8\overline{)8}}$	$\overset{9}{8\overline{)72}}$	$\overset{4}{8\overline{)32}}$	$\overset{0}{8\overline{)0}}$	$\overset{8}{8\overline{)64}}$
$\overset{4}{9\overline{)36}}$	$\overset{5}{9\overline{)45}}$	$\overset{8}{9\overline{)72}}$	$\overset{1}{9\overline{)9}}$	$\overset{0}{9\overline{)0}}$	$\overset{7}{9\overline{)63}}$	$\overset{2}{9\overline{)18}}$	$\overset{3}{9\overline{)27}}$	$\overset{9}{9\overline{)81}}$	$\overset{6}{9\overline{)54}}$

THE CHART

Special work with this chart will increase both speed and accuracy in working longer division examples. Begin with the top row. Cover the answers with a piece of paper. Then divide and write the quotients on the paper. Next, slide the paper up and compare your answers with those on the chart. Fold under the used part of the paper and do the next row.

Have someone read the facts to you one at a time. You give the answer and have the other person check whether or not your answer is correct.

TEST-STUDY CARDS

Cut out cards 1 inch by $2\frac{1}{2}$ inches On one side write the example without the answer. On the other side write the example with the answer. Stack the cards with the test sides face up. Give the answer to the top card, then turn it over to see whether your answer is correct Put aside those you answered quickly and correctly. Put in another pile those that need further study.

$2\overline{)6}$	$\overset{3}{2\overline{)6}}$
TEST SIDE	STUDY SIDE

SPECIAL HELPS IN LEARNING DIVISION FACTS

Here are some general ideas that help children to learn and remember division facts Use the row of division facts below to show that the statements are correct Give other facts that prove the correctness of the statements

$$7\overline{)7}^{\,1}\quad 1\overline{)6}^{\,6}\quad 4\overline{)0}^{\,0}\quad 5\overline{)35}^{\,7}\quad 4\overline{)20}^{\,5}\quad 5\overline{)20}^{\,4}\quad 9\overline{)27}^{\,3}$$

When we divide a number by itself, the quotient is 1 Example $7\overline{)7}=1$

When we divide a number by 1 the quotient is the same as the number Example $1\overline{)6}=6$

When we divide 0 by any number, the quotient is 0 Example $4\overline{)0}=0$

Any number ending in 0 or 5 can be divided by 5 Examples $5\overline{)35}=7$ $4\overline{)20}-5$

When we know that $4\overline{)20}=5$, we know that $5\overline{)20}=4$

When the sum of the two figures in the number being divided is 9, the number can be divided by 9 *Example $9\overline{)27}(2+7=9)$*

Group II Division of two-place numbers not ending in 0, with no difficulties in estimating the quotient *Examples* $31\overline{)62}$ $23\overline{)48}$ $24\overline{)55}$ $43\overline{)129}$ $21\overline{)127}$ $41\overline{)300}$ $75\overline{)473}$ $79\overline{)402}$

In the first three examples in Group II, the quotient is found by dividing the first figure in the dividend by the first number in the divisor, which we call the *guide figure* In the other examples in this group, the first figure in the dividend is smaller than the guide figure In these, the guide figure must be divided into the first two numbers of the dividend

Group III Dividing by two-place numbers when difficulties in estimating the quotient are encountered Examples $21\overline{)80}$ $24\overline{)91}$ $25\overline{)120}$ $37\overline{)138}$ $65\overline{)611}$ $29\overline{)236}$ $39\overline{)271}$ $15\overline{)80}$ $16\overline{)135}$

The difficulty in Group III arises out of the fact that the method of estimating the quotient used in Group II above does not give the correct quotient Thus, the quotient of $21\overline{)80}$ is not 4 $(2\overline{)8})$, but 3, since $4\times21=84$, which is a larger number than the number being divided So, 3 is the correct quotient We say that the estimated quotient is too large and must be made correct by making it at least 1 smaller In Group III, the estimated quotient is too large in all cases and must be made smaller until the correct quotient is found For example, in $39\overline{)271}$, the estimated quotient, which is 9, must be corrected three times because 6 is the correct quotient number

It is so difficult to find correct quotients when dividing by the teens, as in the examples $15\overline{)80}$ and $16\overline{)135}$, that the teens have been called the "division demons" In many schools division examples such as those in Groups I and II are taught in the fifth grade, while those in Group III are not taught until the sixth grade

The difficulty of division examples is further increased when there are two or more figures in the quotient Examples in which zeros are used as place holders in quotients also present considerable difficulty, especially when children do not understand the function of 0 as a place holder (*see* Number System)

How to Check Division Examples

Because of the many computations that are necessary in working a division example, the work should be gone over a second time at each step to correct errors

The quotient can also be checked by multiplying the quotient by the divisor and adding the remainder, if there is one, to the product If the final number is the same as the number being divided, we can be quite sure that the quotient is correct The procedure is shown in the example at the left (*See also* Arithmetic, Number System, Addition, Subtraction, Multiplication, Fractions, Decimals)

Work	Check
$$\begin{array}{r} 3 \\ 23\overline{)84} \\ \underline{69} \\ 15 \end{array}$$	$$\begin{array}{r} 23 \\ \underline{\times 3} \\ 69 \\ \underline{+15} \\ 84 \end{array}$$

DODO "Simpleton' (*duodo*) was the name Portuguese explorers gave this strange bird when in 1505 they discovered it on the island of Mauritius in the Indian Ocean It was so clumsy and stupid it lost the struggle for survival and has been extinct since 1681 Some specimens taken to Europe late in the 16th century lived for many years The picture below was sketched from life The drawing was discovered in 1950 in an art gallery in Sacramento, Calif An almost complete skeleton in the British Museum was built up from bones found in Mauritius

In structure the dodo was related to the pigeon family, but it was not at all like a pigeon in appearance It had a round fat body twice as large as a turkey s with short legs which could scarcely support its weight Its tail was only a little tuft of curly feathers, its wings were small and imperfect and of no use for flying and its head was very large with an enormous hooked bill It was so slow-moving that sailors hunted it with clubs, killing great numbers Dogs and hogs ate the eggs and young birds

A near relative of the dodo, the *solitaire*, which was also a gigantic flightless pigeon, inhabited the island of Rodriguez, near Mauritius It survived the dodo by about 80 years

THE ONLY DRAWING OF A DODO FROM LIFE

This picture by a Flemish artist Roelandt Savery, was found in the Crocker Art Gallery, Sacramento, Calif, in 1950

DOGS—
MAN'S OLDEST
and Most
FAITHFUL FRIENDS

DOGS. More than any other animal, the dog has an inborn sense of friendship with people. He gives all his love and loyalty to the human family with which he lives. He enjoys their petting and praise and he is saddened by their scolding. The dog will do his best to protect his human family, risking his life if necessary.

A dog at home is a member of the family. He plays with the children and takes walks with the adults. He goes with the family on rides and picnics. At home he has his own place to sleep and his regular mealtimes. The family keeps him clean and nurses him when he is sick. "Mutt" or show dog, he repays care with deep devotion.

Dogs have lived with people for thousands of years, but they still keep many habits of their wild ancestors. They chase moving objects—a cat, a car, or a stick thrown out for them. They like to play with other dogs and join in a fight or a chase. They have a good sense of direction and can find their way home from some distance. Before lying down they turn around and around, just as their wild forebears did when they trampled tall grass to make a bed. They bury bones for safekeeping; and they howl at night—their ancestral habit of calling to their mates. They may even roll in filth to hide their own odors—a trick learned by dogs who hunted ages ago.

When primitive men began to tame the wild dogs, they found only a few different breeds. They saw that some dogs had big, muscular bodies, capable of carrying heavy loads. Other dogs had a keen sense of smell, good for scenting game. Still others showed skill at protecting flocks. To keep and even improve these qualities in the offspring, men began mating male and female dogs with similar abilities. As a result of this *selective breeding* over thousands of years, many new breeds with special qualities came into being.

Today American breeders and kennel clubs divide the many breeds of dogs into six large groups: *working dogs, sporting dogs, hounds, nonsporting dogs, terriers,*

Alert and intelligent looking, these Pointer puppies show the appealing traits that make dogs the most beloved animal pets

and *toys*. As their names indicate, the groups are made up of dogs of special types. Regardless of group, nearly every breed is also liked as a pet. A dog of mixed breeds is often a good pet too; his special abilities depend on what "blood" is strongest in him. (A table given later in this article lists all the breeds with their standard characteristics.)

Working Dogs Help Man

The working dogs perform many tasks. Since very ancient times some breeds have helped men herd sheep and cattle. At night these dogs protect their charges against wild animals. In the daytime they round up strays and keep the herd together. Some herd dogs watch over milk cows; at the same time each evening they drive the cows home to be milked. Dogs help cowboys drive beef cattle overland to new ranges or on their way to stockyards.

Some working dogs are strong enough to pull a small cart carrying a passenger or a fairly heavy load. In eastern Canada, in Belgium, and in the Netherlands, dogs haul farm produce to market or pull small bread or milk route wagons along city streets. The most famous harness dogs are the sled dogs of the Far North. Eskimos and northern Indians use them for travel over snow. These dogs hauled explorers' sleds in the heroic drives to reach the North and South Poles (*see* Polar Exploration). Sled dogs work and keep healthy in wintertime temperatures that reach 50 degrees below zero.

Working dogs have a fine record of rescues. They have saved drowning persons or travelers lost in deep

snows and people in burning homes Many children owe their lives to quick acting dogs that pushed them out of the way of oncoming cars Guide dogs for the blind are popularly called see ng eye dogs (from the name of one organization that tra ns such dogs) Sighted trainers teach the dogs their spec al duties then the blind persons receive instruction in how to live with and rely on the r dogs

In the first World War armies used dogs for carry ing messages patrolling lines and bringing aid to the wounded During the second World War dogs were used mainly as scouts and sentries Dog owners do nated 21 000 dogs to the American armed forces and about 13 000 were a tually used Nearly a third of these were killed or died during service After the war several hundred had to be destroyed as incorri gible The most satisfactory dogs were German Shepherds Coll es (usually farm type) and Doberman Pinschers Dogs accepted for serv ce were between one and five years old and weighed at least 50 pounds

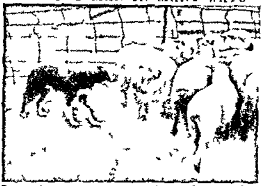
Sporting Dogs for Hunting

The bird dogs so called because they are mainly used in hunting feathered game include the pointers setters and the Brittany Spaniel Po nters are used in the fields and woods to find upland game birds—partridge quail grouse and pl easant When the pointer scents the bird he stands rig i ind cating the *bird to his master with the direction of h s tensely* fixed body Nowadays setters also point in the same way but originally they were tra ned to set or crouch on all fours the r bodies in line with the scent

Both po nters and setters are taught to *retrieve* that is to find and bring back game after it has been shot The retriever breeds specialize n this work They swim after ducks shot over water or go through swamp and tangled th cket after the birds

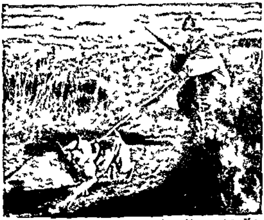
The spaniels (so called because they orig nated in Spain) are good at locating and *flushing* game They range ahead of the hunter seeking the quarry s scent After they drive the game from cover they draw

SERVING MAN IN MANY WAYS

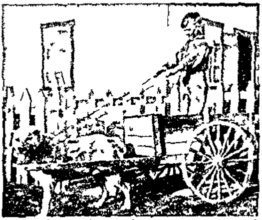


Dr v ng sheep into a wire enc osure is a job that this herd ng dog does alone and without help or direct on from his master

This sturdy dog of the Far North carries a heavy pack for his Eskimo master He can a so work in harness as a sled dog



In Korea th s dog goes on patrol w th h s soldier master H s sensit ve nose sniffs out the presence of hidden enemies



On a Quebec farm this dog pulls a small cart carrying varied farm loads or even a young passenger who handles the re ns

A CLEVER DOG PERFORMER

A member of a famous performing dog act, this Yorkshire Terrier actually pushes and guides the scooter along the stage.

back out of the line of fire. Spaniels are also good retrievers. The Cocker Spaniel, in recent years the most popular dog in the United States, got his name because he was first used in woodcock shooting.

How Hounds Pursue Game

The *scent hounds* have particularly keen noses. These smooth-haired dogs, many of them with sad, wrinkled faces and large floppy ears, are not fast runners, but they have great endurance. They often run in packs, following the trail of one animal through the confusion of many other smells. The foxhounds were bred for the centuries-old sport of "riding to hounds." A captive fox is released, and, soon after, a pack of foxhounds are sent after it. Then riders on horseback follow wherever the pack goes in pursuit of the fox—across fields, over fences and hedges, through streams. Usually the fox escapes, but the riders have had the thrill of an adventurous chase.

Hunters can follow other scent hounds on foot. The Beagle and the Basset find game in protective thicket. The low-slung Dachshund (German for "badger hound") is expert at digging badgers out of their holes. Coonhounds specialize in "treeing" raccoons. They drive the animal up a tree, then stand at the base of the tree, baying loudly until the hunters come. The big Bloodhound has the best sense of smell of all dogs. Police and sheriffs use him to trail fugitives and lost persons.

The *sight hounds* are the swiftest runners in all dogdom. They run a swift, gallоplike pace and at times seem scarcely to touch the ground. At dog-racing tracks, Greyhounds show their speed as they pursue a mechanical "rabbit" around the course.

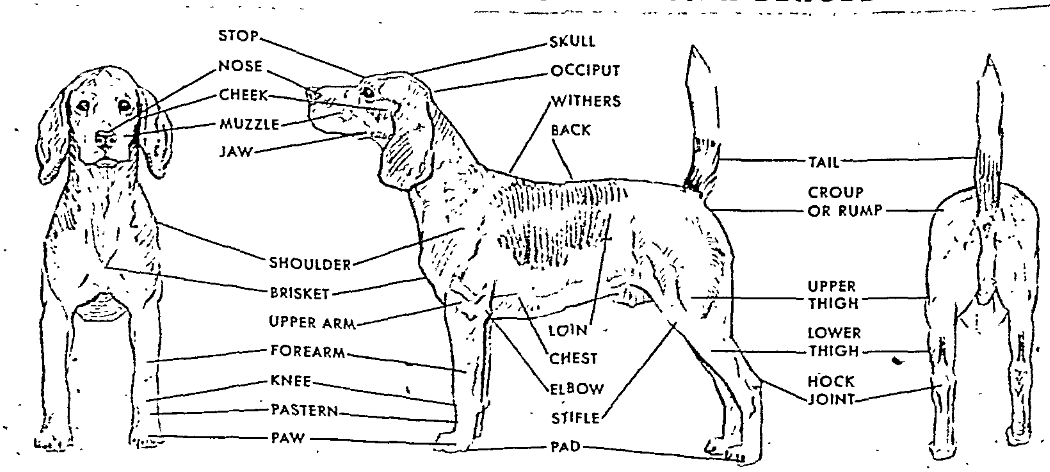
The Tenacious Terriers

Nearly all terrier breeds originated in the British Isles. One exception is the Lhasa Apso, which comes from Tibet. At first there were only two general types in Britain. One was wire haired; the other, smooth haired. The wire-haired dogs were developed into such breeds as the Airedale, Welsh, Wire-Haired Fox, and Scottish Terriers. The smooth-haired type produced the Smooth-Haired Fox, Manchester, and Bull Terriers. The Airedale is the largest of the terrier breeds and has often been used in hunting big game, such as mountain lions.

Nonsporting Dogs—Well-Liked Companions

The squat, muscular Bulldog and his small relatives, the Boston Terrier and the French Bulldog, are popular members of the nonsporting group. The Bulldog is an English breed, developed many centuries ago for the cruel sport of bull-baiting. In this, the dog tormented a chained bull to entertain an audience. The sport was outlawed in 1835. Today the Bulldog, though still brave, is a gentle and friendly pet.

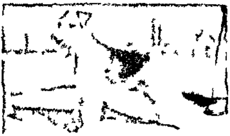
PARTS OF A DOG AS NAMED ON A BEAGLE



Continued on page 116c

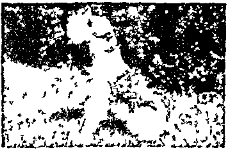
TERRIERS

The active courageous terriers got their name from the Latin word *terra* meaning earth These dogs were bred to *go* into the earth after badgers woodchucks rats and other farm pests that live in holes and burrows The terriers have strong legs and nails for digging and powerful jaws for pulling animals out of their holes Many of them have rough or wiry coats

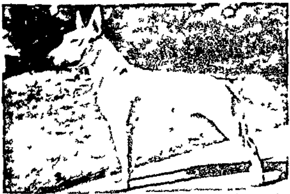


WELSH TERRIER Once called the Old English Terrier the Welsh is probably the oldest of all terrier breeds

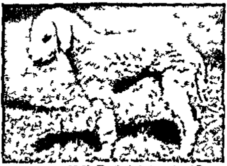
KERRY BLUE TERRIER Named for County Kerry Ireland and for the color of his coat this handsome terrier is a good retriever and herder



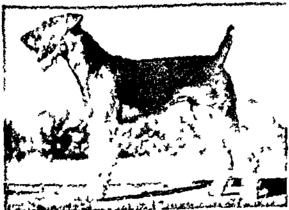
WIRE HAIRED FOX TERRIER This dog *now a popular* pet was originally bred to go after foxes in their burrows



BULL TERRIER Notice the resemblance between this stocky muscular terrier and his ancestor the Bulldog which is shown on a later color page

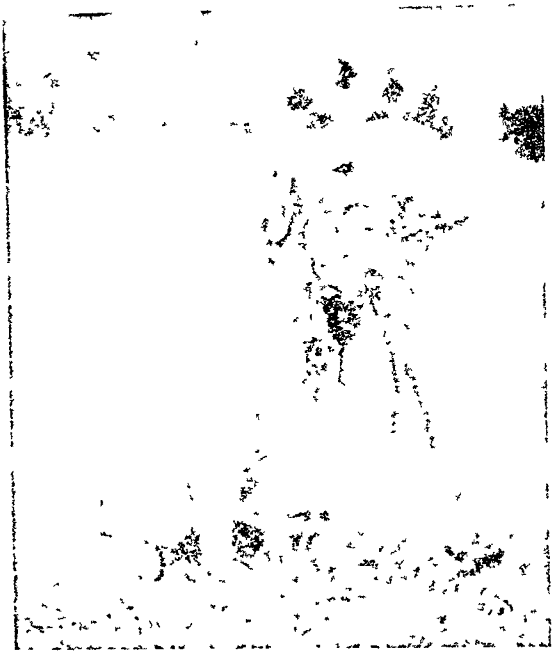


BEDLINGTON TERRIER His thick linty coat and Roman nose give this terrier a distinctively lamblike appearance



AIREDALE TERRIER Largest of all the terrier breeds the Airedale has been used in hunting big game in police work and as a war dog

SCOTTISH TERRIER Short legged and wide-chested the friendly wiry-coated Scottie toes in as he walks or trots



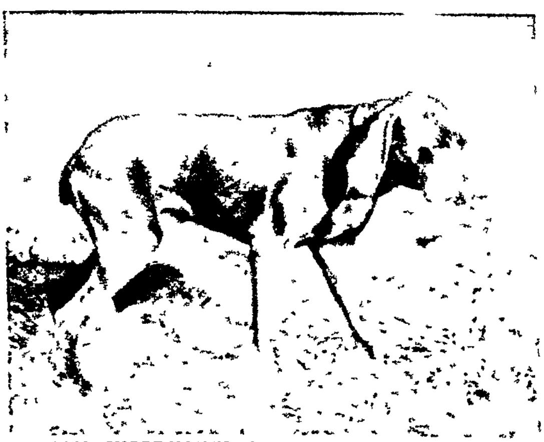
GOLDEN RETRIEVER. Holding a game bird gently in his mouth, this fine silky-coated retriever is ready to present it to his master

SPORTING DOGS

The hunting season is the time when the sporting dogs come into their own. In woods and fields and on the shores of lakes and marshes they work with hunters in their quest for game birds or animals. These dogs have a natural ability for hunting, but they must be trained when young to be unafraid of gunfire, to obey the hunter's commands, and to carry out their special jobs in the sport of hunting. Once trained, sporting dogs usually retain their skills for life, even though the hunting seasons are short. Because of their obedience training they make good pets and companions throughout the year.

LABRADOR RETRIEVER. This dog will swim through the coldest water to retrieve game. He also works well in woods and fields.

CHESAPEAKE BAY RETRIEVER. For shooting over marshes and bays and for upland game, this dog is an ideal hunting companion.

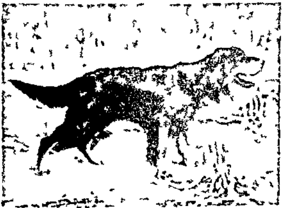


GERMAN SHORT-HAIRED POINTER. A versatile hunter, he points and flushes game and retrieves on both land and water.

WEIMARANER. Nicknamed the "gray ghost" for his color and grace, the Weimaraner is a skilled pointer and retriever.

POINTER His whole body held in a graceful point this dog is showing his master that a game bird is hiding just ahead.

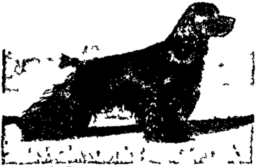
ENGLISH SETTER Like his Pointer companion this trained setter has caught the scent of game and has "frozen" into a point



GORDON SETTER The Black and Tan Setter as he's sometimes called is known for stamina rather than for great speed

IRISH SETTER Beauty grace in motion and pointing skill help make the Irish Setter a popular pet show dog and hunter

ENGLISH SPRINGER SPANIEL For flushing and retrieving pheasants and rabbits this spaniel is an efficient field hunter

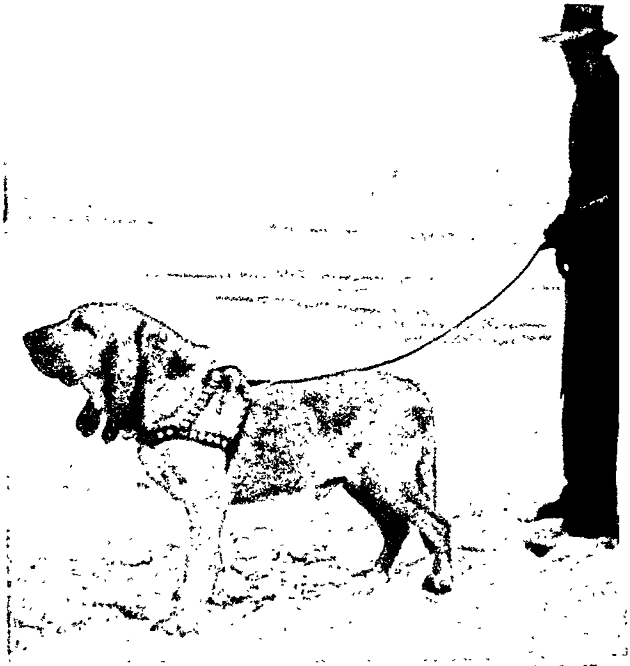


COCKER SPANIEL The friendly Cocker smallest of the spaniels is admired for ability in the field and beloved as a house pet.

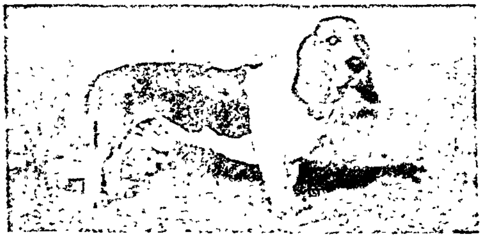
HOUNDS

Often baying as they run, the hounds range ahead of the hunters in the field. Some of the hounds are swift runners and can keep the game in sight. Others depend on their keen noses to stay on the trail. The largest hound, the Irish Wolfhound, and the smallest, the Dachshund, are shown here.

BEAGLE. The Beagle's patience on the trail makes him a good rabbit hunter. He is also a frisky and friendly pet.



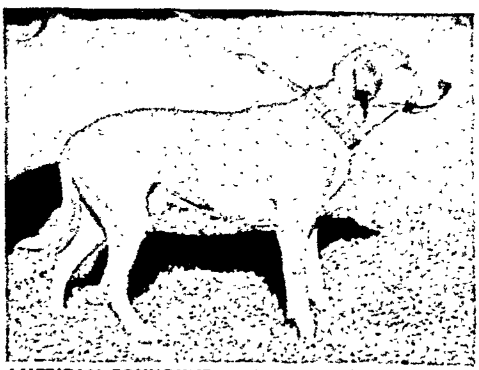
BLOODHOUND. This keen-scented Bloodhound is leading his sheriff-master along the trail of a lost person. Note the special harness and lead.



BASSET HOUND. The long-eared Basset is strong and heavy. He is an expert trailer of all furred game.

IRISH WOLFHOUND. Largest and heaviest of the hounds, this dog makes a gentle pet. As a hunter he is more than a match for a wolf.

DACHSHUND. Now a well-liked house pet, this hound was originally bred to go after badgers in their holes.



AMERICAN FOXHOUND. This dog runs in a pack ahead of mounted hunters and on the trail of a fleeing fox.

AFGHAN HOUND. The lean, rangy Afghan is swift enough to run down an antelope or a gazelle. He also leaps hurdles with ease and grace.

NONSPORTING DOGS

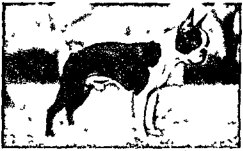
The nonsporting group of dogs are all popular pets but only a few—such as the Bulldog and the Boston Terrier—are closely related to each other. All rank high in intelligence and in their affectionate dispositions although some such as the Chow Chow tend to be "one man" dogs. Despite their group name some of these dogs are used for hunting.

CHOW CHOW This handsome Chinese dog is the only canine with a blue-black tongue. He makes a good house companion and watchdog.

POODLE The stylish Poodle is an attractive and likable pet. He does tricks readily and is popular as a circus and stage performer.

KEESHOND (plural KEESHONDEN) *This Dutch dog* was the favorite of Netherlands barge captains. His stiff coat needs no brushing.

DALMATIAN Shown here on a fire engine running board the Dalmatian has been traditionally the pet of firemen.



BOSTON TERRIER A breed that originated in the United States the Boston has both Bulldog and terrier blood.

SCHIPPERKE This Belgian dog's name can be translated as "captain" or "skipper." He is small, lively and friendly.

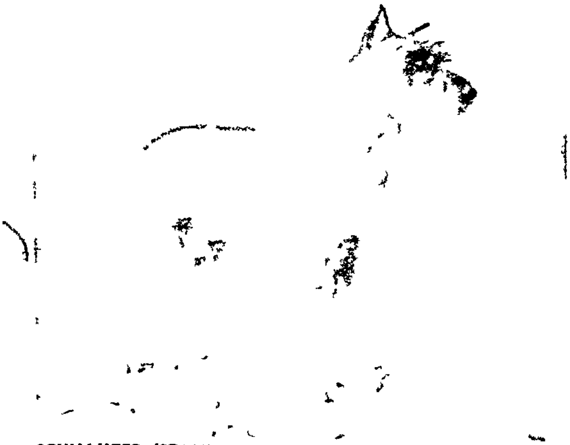
BULLDOG The Bulldog combines a ferocious look and great strength with a gentle disposition and good house manners.

WORKING DOGS

This group of dogs has had a long history of useful service to man. As herders, watchdogs, sled and draft dogs, and as guide dogs for blind persons, they have put their strength and intelligence to practical use. Many of these breeds have been taught to hunt. Like other dogs, the working dogs make good companions Their devotion to their masters—adults or children—has been shown time and again by brave rescues and other feats of heroism.

WELSH CORGI (PEMBROKE) Bred as a herder, this dog is also a fine pet

BOXER Both the full-grown Boxer and the puppy show the muscular lines of this breed.

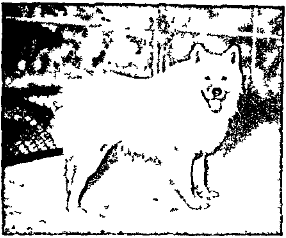


SCHNAUZER (STANDARD) This German dog is a good rat-catcher and watchdog He has also been trained to retrieve game

GERMAN SHEPHERD DOG This breed is one of the preferred dogs for guiding blind persons Notice the special harness.

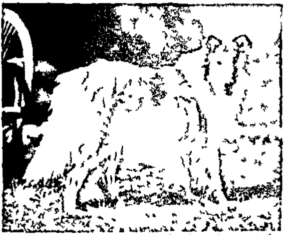
GREAT DANE Tall and handsome, the Dane is sometimes called a German Mastiff He originated in Germany, not Denmark.

NEWFOUNDLAND A strong swimmer in icy waters, the big Newfoundland dog has a notable record of saving drowning persons.



SAMOYED In the Far North this powerfu s ed dog can pull one and a half times his own weight along the trail for days

ALASKAN MALAMUTE Swiftest of the sled dogs of the Far North these Malamutes a so have great endurance and pull ng st ength



COLLIE With his aristocratic head and h s glossy coat th s Scott sh bred sheepherder is one of the most beau ifu of dogs

OLD ENGLISH SHEEPDOG The ha r over h s eyes is natural to this shaggy-coated dog and he sees perfectly well through it

ST BERNARD Members of th s shaggy powerful b eed were *famous for rescuing travelers lost in the snows of the Swiss A ps*

DOBERMAN PINSCHER The strong smart Doberman is one of the dogs preferred by the armed forces for guard and patrol work.

TOY DOGS

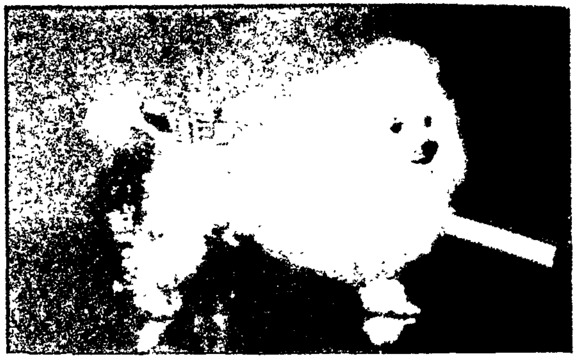
These dogs are small in size, but they possess all the intelligence and affection of the larger canine breeds. Cheerful and obedient, toy dogs are especially well suited for living in small apartments in cities.

CHIHUAHUA. Smallest of all breeds, this dog's first home was in ancient Mexico. He weighs only one to six pounds.

PEKINGESE. From his heavy mane, the "Peke" was once called the Lion Dog, and from his golden coat, the Sun Dog.

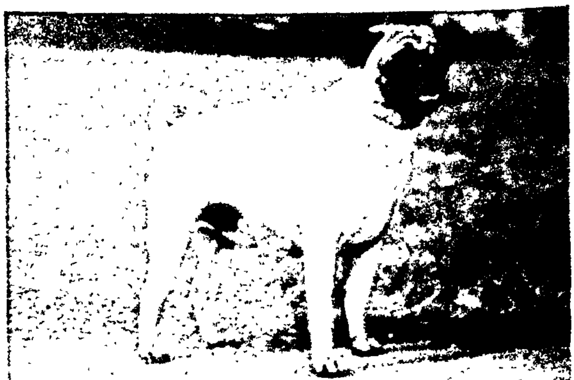
POMERANIAN. Lively, smart, and with a keen sense of hearing, the fluffy-coated "Pom" makes a good watchdog.

YORKSHIRE TERRIER. This toy's coat is black at birth, but when full grown he shows these rich, beautiful colors.



TOY POODLE. Size alone makes this Poodle a toy. Otherwise he is identical in appearance with the larger Miniature and Standard Poodles.

TOY MANCHESTER TERRIER. The Toy Black and Tan, as this toy dog is sometimes called, has erect, pointed ears and snappy black eyes.



PUG. A tightly curled tail and a blunt, square face are characteristic of this toy breed. The Pug is the largest of all toy dogs.

BRUSSELS GRIFFON. This Belgian toy's heavy whiskers give his face an appealing, almost human expression. He has a harsh, wiry coat.

The Dalmatian is often called the coach dog because in England he ran with his master s coach or carr age Pacing between the wheels he could run for m les At the end of the journey he stood guard over the veh cle Dalmatians are often found to lay as pets of firemen at station houses

Tl e long furred Chow Cl ow a pet in the United States is still used as a hunt ng dog in his native China Sch pperkes and Keeshonden were the pets of the barge captains in the Low Countries (In Flem ish schipperke means little captain) The Poodles with their cropped coats have a very showy appearance Often called French Poodles because of their popularity in France these dogs are very intelli gent They are widely used in circus and stage acts

Tiny Toy Pets

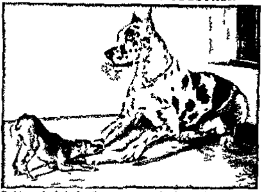
The toy breeds are rarely more than ten inches high at the shoulder or more than e ght pounds in weight Some such as the Toy Manchester Terrier and the Italian Greyhound are more or less smaller varieties of the larger breed Othe s as the Chihuahua and the Maltese have been individual breeds as far back as historians can trace them Still others the English Toy Spaniel and the Pap llon for example are probably dwarf descendants of the or ginal span iels of Spain Tl e Papillon (French for butterfly) gets its name from its ears shaped like butterfly wings

Centuries ago the toy dogs were prized by wealthy people Many of them were sleeve dogs carried in the lower sleeves of their owners their heads peep ing out at the cuffs Today they are popular house pets especially suited for small living quarters

Fundamental Facts about All Dogs

From the giant Great Dane to the tiny Chihuahua dogs present an amazing range of phys cal differences

BIG AND LITTLE PLAY TOGETHER



Fighting playfu ly for the possession of a bone the M niature Pinscher and the Great Dane remain good friends Once they know each other dogs seldom quarrel

Generally speak ng however all dogs have many fundamental likenesses Big or little shaggy or smooth they all have nearly the same development of senses bone structure body organs and l fe processes They eat the same kinds of foo ls are subject to the same illnesses and all can be trained in much the same way

Dogs learn fairly rapidly from instruction and from experience They have good memories and to some ex tent they show foresight The average dog can easily be tra ned to respond to a dozen different commands An intelligent dog when well coached can d stinguish more than a hundred words and phrases

A dog s keenest sense is that of smell He lives in a world of odors Many odors which go unnot ced by humans are eas ly sensed by dogs Hearing is

TEACHING A DOG TO OBEY THE COMMAND SIT! '

Pulling up on the leash with one hand and pressing down on the dog s rump with the other hand th s young girl is teaching her pet to respond to her spoken command "S t! After a few such lessons with a reward after each the dog will soon obey

YOUR PET NEEDS PROPER CARE

Like people, dogs get sick or hurt and need care. Here a boy brings his pet to a veterinarian for treatment of a foot injury.

another acute sense. The dog will bark at approaching footsteps long before they are heard by his master, and he can tell the exact direction from which the sound comes. He can hear sounds too high in pitch for the human ear to catch. The "silent" dog whistle makes a sound pitched above the level of human hearing but within the hearing range of a dog.

Sight is less highly developed than the senses of smell and hearing. The dog's eyes do not change focus quickly, nor does he readily tell colors apart. However, he quickly detects motion. His sense of touch is somewhat dulled by his thick coat and padded paws.

Body and Life Processes

Before man tamed him, the dog was a hunter who killed animals for his food. His 42 teeth (22 in the lower jaw, 20 in the upper) are adapted for tearing meat; the dog does little chewing. His two pairs of fangs are especially useful, and in dogs and other meat-eating animals including man these are called *canine* teeth (*see* Teeth). His muscular chest is supported by 13 pairs of ribs, one more pair than man has (*see* Skeleton). The dog's tail, an extension of his spinal column, is made up of 20 or more vertebrae joined by flexible cartilage. He has five "toes" on his forefeet and four on his hindfeet. He cannot pull in (retract) his claws as a cat does.

Like many other furred mammals, many dog breeds have coats made up of long *guard hairs* and short *fur fiber*. The lustrous guard hair is somewhat oily and helps the dog dry off quickly. The fur fiber helps keep him warm. The long, silky hair on a setter's legs is called *feather*.

Pulse rate in a dog varies greatly with age, size, and breed. For a healthy medium-sized dog a pulse rate of about 90 beats per minute is normal. A good place to take a dog's pulse is high on the inner side of the thigh where the femoral artery comes close to the skin. His normal rectal temperature varies from 100° to 101° F. A dog does not perspire through his skin. After exertion or in hot weather he pants heavily, his long tongue hanging out for freer mouth breathing.

A female dog, or bitch, is ready for mating about twice a year for a period of several days each time. During these times she is said to be in season, or in *heat*. Her litter of puppies is born about 63 days after conception. This gestation period may vary one or two days either way. Larger dogs frequently have nine or more puppies in a litter; smaller dogs average three or four. Dogs reach maturity between 14 and 20 months of age. Their lifespan is about ten years, although some dogs have lived 20 years or longer. Medium-sized breeds usually live the longest.

Selecting a Dog

Before you can make a wise choice of a dog you should answer several questions for yourself. Will both you and this breed be happy together in your type of home—a city apartment, a house with a yard or garden, a farm? Will the dog make a good companion for small children in the family and neighborhood? Is he expected to be a watchdog or a hunting dog as well as a pet? Above all, and regardless of breed, are you ready to give him the care and love *all* dogs need?

OVER THE WORLD, THE DOMESTIC DOG HAS MANY

The dingo is the wild dog of Australia, preying on rabbits and sheep. Some dingoes have been trained as pets. The coyote belongs to the wolf family and is found on the prairies of western North America. The grey, or timber, wolf is a relat-

KEEN COMPETITION AT A DOG SHOW

Each of these hounds has already been judged Best of Breed Now they are competing for the title of Best of Group The winner will be Best Hound and will receive a blue rosette or ribbon They also win points that count toward the Champ on rating

If you have never had a dog before you will do well to select a puppy between three and six months old At th s age a pup properly cared for at a repu table kennel will have received permanent distemper inoculations and be over h s first cycle of wormings

Be sure that he is healthy with good legs and well formed bones Look for one that is not afraid of noises and is bold rather than shy Do not be too partial to males The female often is more devoted cleaner a better companion and eas er to train

One of the first problems is to teach a new dog his house manners For out-of-doors housebreaking con fine the puppy at night to a small box or any small space He will try to avoid soiling his bed or the floor close to it Take him out early in the morning say ing as you do Out out want to go out? Do not pet him until he has obeyed Then make a fuss over him and give him a tidbit Do this several times a day and the dog will soon learn what is expected of him

If he makes a mistake—and most of them will dur ing this period—do not whip him Just hold him close

WILD RELATIVES

less killer of wild anima s and livestock Notice how closely cer tain head features of this red fox resemble those of some dogs.

to the offense and say Shame no no-o Let your voice and act ons show you are displeased and he will soon understand that he has done wrong Use much the same routine if you want to teach the puppy to use newspapers or a box of sawdust or sand indoors

To teach your dog to respond to the command Come! take him outside where there are no other people or other dogs Attach a long cord to his collar then let him run as he pleases for a bit When he is 15 or 20 feet away from you command him sharply Sport come here! Then pull on the cord If he does not come at once pull him in Then reward him with a tidbit Repeat this several times Wa t about an hour and give him another lesson He will soon learn to come when called Other commands are similarly taught.

Feeding Your Dog

Recommended diets for dogs vary widely but all good ones contain balanced amounts of protein in the form of meat carbohydrates in cereal form fat vita mins and minerals Your dog can eat table scraps usually these must be balanced with some dog foods Give your dog a large bone once a week or so He gets little if any nutrition from it but the chewing helps prevent formation of tartar on his teeth He should not be fed small bones especially poultry bones They are liable to splinter and stick in his throat or digestive tract Any change in diet should be introduced gradually A new puppy needs to be fed several times a day Grown dogs need only two meals a day many authorities recommend only one

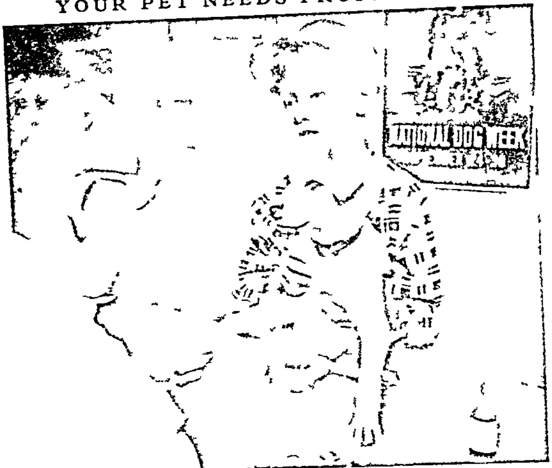
Bathe your dog only when he absolutely needs it Use tep d water and mild soap and keep suds away from his eyes ears and nose Dry him well and keep him indoors unless the weather is warm Brushing him regularly keeps his coat clean and healthy

How New Breeds Have Been Created

The wild forebears of the modern domestic dogs had a common ancestor who lived millions of years ago This prehistoric animal (*Tomarctus*) which resembled the civet cat, was also the ancestor for the dog s wild

Continued on page 120

YOUR PET NEEDS PROPER CARE



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WILD RELATIVES

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Continued on page 120

AMERICAN KENNEL CLUB BREEDS AND STANDARDS

SPORTING DOGS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Griffon (Wire-Haired Pointing)	Steel gray with chestnut splashes; gray-white with chestnut splashes; chestnut; dirty white with chestnut mixed	21½–23½ 19½–21½	50–65† 40–55†
Pointer	Usually white with lemon, black, or tan markings; can be solid black or solid white or flecked	22–26† 20–24†	50–55 45–50
Pointer (German Short-Haired)	Must be liver colored—solid or with white spots or flecks	23–25 21–23	55–70 45–60
Retriever (Chesapeake Bay)	From a dark brown to a faded tan	23–26 21–24	65–75 55–65
Retriever (Curly-Coated)	Black or liver	20–22	50–60†
Retriever (Flat-Coated)	Black or liver	21–24†	60–70
Retriever (Golden)	Rich golden	23–24 20½–22	65–68 55–60
Retriever (Labrador)	Usually solid black. Other colors: yellow and cream	22½–24½ 21½–23½	60–75 55–70
Setter (English)	Black, white, and tan; black and white; blue belton; lemon and white; lemon belton; orange and white; orange belton; liver and white; liver belton; solid white	25 24	55–70 50–65
Setter (Gordon)	Coal black with tan markings	24–27 23–26	55–75 45–65
Setter (Irish)	Rich golden chestnut or mahogany red; some white markings permitted	25–28† 22–26†	50–70† 45–60†
Spaniel (American Water)	Solid liver or dark chocolate	15–18	28–45 25–40
Spaniel (Brittany)	Dark orange and white or liver and white; no black in coat	17½–20½	30–40
Spaniel (Clumber)	Lemon and white; orange and white	18–19†	55–65 35–50
Spaniel (Cocker)	Black; red; liver; fawn; roan. White with red, liver, black, orange, or tan	14–16†	22–28
Spaniel (English Cocker)	Various, such as black; red; liver; fawn; tan-orange; roan; black with tan. White with black, red, liver, fawn, tan-orange; or any of these colors as tricolor	15–17†	28–34 26–32
Spaniel (English Springer)	Liver and white; black and white; liver and tan; black and tan; tan and white; black; white; roan	18½ 18	45–50 42–47
Spaniel (Field)	Self-colored—black; or sports from black, such as liver, golden liver, mahogany red, roan—any of these with tan over eyes	18	35–50
Spaniel (Irish Water)	Solid liver	22–24 21–23	55–65 45–58
Spaniel (Sussex)	Rich golden liver	16–18†	35–45
Spaniel (Welsh Springer)	Dark rich red and white	18–19†	40–50†
Weimaraner	Gray (silver, bright, dark, or yellow); dark gray may be either ash or blue	24–26 22–25	65–85 55–75

HOUNDS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Afghan Hound	Any color; common ones are fawn, black, sandy, white, gray	26–28 24–26	60† 50†
Basenji	Chestnut, black, red, fawn—each with white; black and tan with white	17†	25†
Basset Hound	Any recognized foxhound color, such as black saddle with tan and white markings (*see* Foxhound, English)	13†	45†
Beagle	Any true hound color (*see* Foxhound, English)	11–15†	18–26†

*Where two sets of figures are given, upper figures are for the male, lower for the female. Where only one set is given, it applies to both sexes. Height is measured in a straight vertical line from the level plane of the shoulder to the ground.

†Breed standards do not give specific heights and/or weights; these figures are approximations.

AMERICAN KENNEL CLUB BREEDS AND STANDARDS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Bloodhound	Black and tan red and tan tawny (sandy)	25–27 23–25	90 80
Borzoi	All white all black predominantly white with lemon tan brindle gray or black	28 31 26–29	75 105 60–85
Coonhound (Black and Tan)	Coal black with rich tan markings	25–27 23 25	80† 70†
Dachshund	For smooth coated and wire-haired red or tan red yellow yellow deep black chocolate gray white—each with rust-brown or yellow markings dappled or tiger striped brindle For long haired any color	7½–9½† 7½ (miniature)	16–20† (miniatures under 9)
Deerhound (Scottish)	Any color dark blue gray usually preferred Other common colors yellow sandy red red fawn	30 32 28 minimum	85 110 75–95
Foxhound (American)	Any color most common is black saddle with tan body and white markings	22 25 21 24	35–45†
Foxhound (English)	Hound colors—namely black tan and white black and white white bodied with pied patches of yellow tan rabbit gray or badger brindle	22 25†	38–48†
Greyhound	Usual colors—fawn white black brindle white with patches	23–27† 22 25†	65–70 60–65
Harrier	Same as English Foxhound (*see* Foxhound English)	19 21	35–45†
Norwegian Elkhound	Gray (long hairs have black tips) dark or light gray with slight shading toward yellow	20½ 18	50 45
Otterhound	Grizzle or sandy with black and tan areas	20 23†	50–70†
Saluki	White cream fawn golden red grizzle and tan black and tan white black and tan	23–28 19 24†	45–55† 35–45†
Whippet	Same as Greyhound (*see* Greyhound)	19 22 18 21	30–40 25–35
Wolfhound (Irish)	Gray brindle red black pure white fawn or any Scottish Deerhound color (*see* Deerhound Scottish)	32 minimum 30 minimum	120 minimum 105 minimum

WORKING DOGS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Alaskan Malamute	Wolfish gray black and white	23 25 20 23	65–85 50–70
Belgian Sheepdog	Groenendael variety is black malinois variety is brindle-fawn	23½ 22½	55 70† 45 60†
Bernese Mountain Dog	Jet black with brown tan markings on all four legs	23 27½ 21 25	60–80† 55 70†
Bouvier des Flandres	Fawn pepper and salt gray brindle black	23½ 27½ 22¾ minimum	70–90† 65–80†
Boxer	Fawn brindle	22 24 21–23	66 minimum 62
Briard	Black black with some white dark and light gray tawny combination of any two of these	23 27 22 25½	70–90† 65–80†
Bull Mastiff	Fawn brindle	25 27 24 26	115 100
Collie	Sable and white white tricolor blue merle	24 26 22 24	60–75 50–65
Doberman Pinscher	Black brown blue all with rust-red markings	26 28 24 26	60 80† 50–65†
Eskimo	Black white black and white wolf gray blue gray, tan buff any combination of these	23 25 20 23	65–85 50–70
German Shepherd Dog	Any color albino white disqualified washed-out *shades not desirable*	25 23	75–85 60–70
Giant Schnauzer	Black black with tan any pepper and salt mixture	21½ 25½	65–90 55–75
Great Dane	Brindle blue black fawn harlequin	30 minimum 28 minimum	130–170† 100 145†

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AMERICAN KENNEL CLUB BREEDS AND STANDARDS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Great Pyrenees	White; white with badger, gray, or tan markings	27–32 25–29	100–125 90–115
Komondor	White	25½ minimum 23½ minimum	90–110† 75–90†
Kuvasz	White	26 23–25†	90–115† 70–95†
Mastiff	Apricot; silver fawn; dark fawn-brindle	30 minimum 27½ minimum	110–160† 90–125†
Newfoundland	Black; white and black; white and bronze	28 26	140–150 110–120
Old English Sheepdog	Gray; grizzle; blue; blue merle; any of these with or without white markings	22–26 21–26†	80–105† 70–90†
Puli	Any color; preferred are white, shades of gray or cream, black	17–20 16–19†	30–40† 25–35†
Rottweiler	Black with tan markings	23¾–27 21¾–25¾	70–100† 65–85†
Samoyed	Pure white; white and biscuit; cream	21–23½ 19–21	50–67 36–55
Schnauzer (Standard)	Black; any salt and pepper mixture	18–20 17–19	40–50† 35–45†
Shetland Sheepdog	Black; blue merle; sable (golden through mahogany); all marked with white and/or tan	13–16	21–27† 18–24†
Siberian Husky	All colors; common ones are white, wolf or sable gray, tan with black and white points	21–23½ 20–22	45–60 35–50
St. Bernard	White with red; red with white; white with brindle patches; all with white markings	26–32† 24–28†	140–200† 120–170†
Welsh Corgi (Cardigan)	Any color except white; preferred in order: red, brindle, black and tan, black and white, blue merle	12	18–25 15–22
Welsh Corgi (Pembroke)	Red; sable; fawn; black and tan with white markings	10–12	20–24 18–22

TERRIERS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Airedale Terrier	Tan with black (black can be dark grizzle)	23 21–22†	45–60† 38–50†
Bedlington Terrier	Blue; blue and tan; liver; liver and tan; sandy; sandy and tan	15–16	24 22
Border Terrier	Red; grizzle and tan; blue and tan; wheaten	13† 12†	13–15½ 11½–14
Bull Terrier	For the white variety, white; for the colored variety, any color other than white	17–21† 16–20†	25–60
Cairn Terrier	Any color except white	10 9½	14 13
Dandie Dinmont Terrier	Pepper; mustard	8–11	14–24
Fox Terrier	Any color, with white predominating; red or liver objectionable	14–16†	17–19 15–17
Irish Terrier	Bright red; red wheaten; golden red	18	27 25
Kerry Blue Terrier	Any shade of blue-gray or gray-blue	18–19½ 17½–19	33–40 29–36†
Lakeland Terrier	Blue and tan; blue; black; black and tan; red mustard; wheaten grizzle	13–15†	17 max. 16 max.
Lhasa Apso	Preferred order: golden; sandy; honey; dark grizzle; slate; smoke; parti-color; black; white; brown	10–14†	11–16†
Manchester Terrier	Black with tan markings	14–17†	20–22
Norwich Terrier	Red; wheaten; black and tan; grizzle	11 max.	15 max. (12 ideal)
Schnauzer (Miniature)	Black; black and tan; any salt and pepper mixture	11½–13½	13–19†
Scottish Terrier	Steel; iron gray; brindled; grizzled; black; sandy; wheaten	10	19–22 18–21

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Sealyham Terrier	Pure white, white with lemon, tan, or badger markings on head and ears only	10½	21 20
Skye Terrier	Dark or light blue, gray, fawn—all with black markings	9 8½	22 26† 19–24†
Staffordshire Terrier	Any color—solid, parti, or patched, all white not encouraged	18 19 17–18	40–50† 35–45†
Welsh Terrier	Black and tan, black grizzle and tan	15 14†	20
West Highland White Terrier	Pure white	11 10	14–17† 13–16†

TOYS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Affenpinscher	In order of preference, black, black with tan, red or gray, other mixtures	10½ max	4 8†
Chihuahua	Any color—solid, marked, or splashed	7 9†	Smooth 1 6 (prefer 2–4) Long 2–8 (prefer 3–5)
English Toy Spaniel	Each of these color combinations is a separate variety, black and tan, solid chestnut red, white with chestnut or ruby red markings, white with tan and black markings	9½–12†	9 13†
Griffon (Brussels)	Reddish brown, black or black with reddish brown markings (for Belgian and Brabançon varieties only)	9½ 11½†	11 max 12 max both 7 aver
Italian Greyhound	All shades of fawn, red, mouse, blue, cream, white	10–16†	5 14†
Japanese Spaniel	White with black patches, white with red patches	9½–12†	4–10†
Maltese	Pure white	8–9½†	7 max (under 3 ideal)
Mexican Hairless	Blue or black spotted or streaked skin, with tufts of white hair on head and tail	12 16†	16–25†
Papillon	Any one, two, or three colors, most common is white body with black or tan or both markings	7–9†	3–6†
Pekingese	All colors, red, fawn, black, black and tan, solid brindle, all white, parti-color	8–9½†	14 max 10 aver
Pinscher (Miniature)	Red, black with tan markings, brown or chocolate with rust or yellow markings	10–11½	6–9 6½–10
Pomeranian	Black, orange, white	8 10†	3–11 6 aver
Pug	Black, fawn (silver or apricot)	11 13†	14–18
Toy Manchester Terrier	Black with tan markings	9–13†	4–12 6 aver
Toy Poodle	Any solid color, as white, black, brown, silver, apricot (tan) (*See also* Poodle, nonsporting group)	10 max †	3–10†
Yorkshire Terrier	Dark steel blue, tan hair on head and legs	8–9†	2½ 7 4 aver †

NONSPORTING DOGS

BREED	COLOR	HEIGHT (in.)*	WEIGHT (lbs.)*
Boston Terrier	Brindle or black with white markings	11–15†	25 max
Bulldog	In order of preference, red brindle, other brindles, solid white, solid red, fawn, or fallow, piebald	13–16†	50 40
Chow Chow	Any solid color, such as black, red, cream, blue	17 20†	40–60
Dalmatian	White with black or liver spots	19–23	35–50
French Bulldog	Brindle, fawn, white, brindle and white	11–14†	28 max
Keeshond	Mixture of gray and black	18 17	35–45†
Poodle	Any solid color, as white, black, brown, silver, apricot (tan) (*See also* Toy Poodle, toy group)	Miniature over 10 under 15† Standard over 15†	13–23† 30–50†
Schipperke	Solid black	9–10½†	18 max

*Where two sets of figures are given, upper figures are for the male, lower for the female. Where only one set is given, it applies to both sexes. Height is measured in a straight vertical line from the level plane of the shoulder to the ground.
†Breed standards do not give specific heights and/or weights; these figures are approximations.

cousins—the fox, wolf, jackal, coyote, cape dog (of Africa), and dingo (the wild dog of Australia). All these belong to the family *Canidae*.

Selective breeding for centuries created the modern varieties of dogs. To create new breeds or to modify certain traits of existing breeds, a male (sire) and a female (dam) which combine the desired characteristics are mated. Only the offspring which show these traits are kept for further breeding. *Inbreeding* (offspring mating with each other or parent with first generation offspring) or *linebreeding* (offspring mating with grandsire, granddam, or other fairly close relative) is usually necessary to start a new breed. Within about eight generations the dogs begin to "breed true," that is, to show the same desirable characteristics as their parents. The undesirable traits or physical features of a more remote ancestor do not appear.

Thus a *purebred* dog is one that has bred true for many generations. His *pedigree* is the record of his forebears for several generations. A *mongrel* is a dog of mixed or unknown ancestry. A mongrel may be a good dog and have many fine traits, but it is never certain that any of the wanted qualities will be repeated in his offspring. (*See also* Heredity.)

The American Kennel Club recognizes 112 breeds of dogs as well as a few varieties within some breeds. Kennel Club recognition means. (1) that the breed is represented by a specialty club; and (2) that definite standards for the breed are in force. As evidence that the breed is entitled to recognition the specialty club presents one hundred or more pedigrees, showing that each dog of the present generation is the product of pure breeding for at least five generations. These pedigrees form the basis for the Kennel Club's stud book on that breed, in which further generations may be registered. There are a number of specialty clubs organized for breeds not officially recognized by the Kennel Club.

THE FIRST BLOSSOMS OF SPRING

The flowering dogwood blossoms while other trees are still bare. The blossom itself is shown at the lower right.

Dog Shows and Field Trials

To try for the coveted title of Champion, purebred, pedigreed dogs are entered in dog show competition. The winners are awarded points based on their conformity to breed standards. A dog may receive a maximum of five points at a show. Before he can be titled Champion, he must win 15 points in all, winning at least three points in each of two shows not judged by the same person.

The important shows are usually *bench* shows. Here dogs are housed in cages or stalls on raised benches while they wait their turn to be judged in the show ring. *Obedience trials* may be held separately or as part of a larger show. Purebred dogs are tested on various required exercises and scored on their performance. *Field trials* are for judging the hunting skill of sporting dogs and sporting hounds. Such abilities as pointing, flushing, and retrieving are tested under realistic conditions in the outdoors.

DOGTOOTH VIOLET. One of the earliest spring flowers in North America is the dogtooth violet or adder's-tongue. The plant is really not a violet. It belongs to the lily family. The bell-shaped flowers may be yellow, purplish, or white. They hang from slender stems 6 to 12 inches high, between two large flat leaves. Sometimes called the trout lily, the plant grows in moist places and along the banks of streams. The name "dogtooth" comes from the shape of the bulbs. (For picture in color, *see* Flowers.)

Scientific name of yellow dogtooth violet, *Erythronium americanum*. Leaves pale green mottled with purple; oblong, lance-shaped. Flowers single, rather large, 6 spreading or recurved sepals, 6 stamens, 1 pistil.

DOGWOOD. Most of the many species of these hardwooded shrubs and trees are found in the temperate regions of the Northern Hemisphere. They all belong to the genus *Cornus* (from the Latin word for "horn," on account of the hardness of the wood). One of the most showy species is the flowering dogwood. The tree blooms in early spring before its leaves unfold and is found as far north as New England and westward to Minnesota. Its large white or pink "flowers" (really petallike bracts) make the tree a conspicuous and beautiful sight in the bare woods. The bitter bark has astringent properties and is sometimes used in medicine. Another handsome species is the western, or Pacific, dogwood, found in the Pacific coast states. Ordinary dogwood bushes, with red and greenish twigs and white, bluish, or red berries, are common throughout the United States. (For picture in color of flowering dogwood, *see* Flowers.)

Scientific name of flowering dogwood, *Cornus florida;* of western, or Pacific, dogwood, *Cornus nuttallii*

DOLLS—
The World's Most Popular Toy


The soft huggable baby doll wants to be picked up

DOLLS A child's favorite doll is much more than just a toy It is a real friend that demands nothing and gives fun comfort and true companionship For the very small child a soft stuffed doll is a lovable partner all the day at naptime and even in the dark of night Though the child may chew it drag it or throw it in the bath dolly does not object and is always ready to snuggle close again

As the child grows and her imagination reaches out she turns to new favorite dolls—more like real little people She tells them her plans her joys and —when grownups do not understand—her heartbreaks In tea parties with them playing house visiting and going to school she learns social ways and graces—how to be friends how to share to help to make conversation and to listen with interest Her dolls always understand These little folk of hers are a kindly and stanch bridge to the big world of grownups

After two or three years at school a little girl finds new interest in her dolls—especially in baby dolls She regards them as younger brothers and sisters and feels responsible for their care As little mother she learns to give her doll its bottle change and dress it and keep it clean and fresh

Her older dolls must be stylish and so she shampoos and waves their hair dresses them in the latest vogue and is careful to change their costumes with the seasons The sale of doll wardrobes and accessories —such as toy irons trunks skates umbrellas wave kits —maintains the profit of many toy departments in the slack season

THEIR COSTUMES REPRESENT FAR CORNERS OF THE WORLD


The young girl in the background helped to dress these *dolls in foreign costumes* She is adjusting the elaborate fete day hat on a young lady from Brazil Note the varied hats

Many girls learn to sew and design by making the clothes and hats for their dolls By taking care of their handiwork they in turn learn to take better care of their own clothes

Doll Collecting

Many girls never become too old for dolls When they no longer play with them their interest grows into doll collecting

This is one of the most popular of modern hobbies among women and even a number of men are collectors In 1937 enthusiasts organized the National Doll and Toy Collectors Club

Inc., which has junior units. Many collectors give exhibits and lectures with their dolls. Among the most famous doll collectors have been Queen Victoria and Montezuma II, last chief of the Aztecs.

Educational Value

Many schools and museums use costume dolls to help boys and girls learn about other lands.

Study of the costume often reveals where a person lives, his work, and conditions of the country. Dolls from Guatemala, for example, are usually garbed in cotton or wool. Those wearing cotton represent the Indians who live in the steaming coastal lowlands. The wool-clad dolls show the dress of the Indians in the cool highlands, where most of the people live. When Guatemalan dolls carry huge head baskets, or *cacastes* (wooden back packs), students can visualize that transportation in Guatemala is largely primitive.

Almost every large museum throughout the world has a doll collection. Among the outstanding in the United States are: Museum of the City of New York; Metropolitan Museum, New York, N. Y.; Los Angeles Junior Museum, Los Angeles, Calif.; Museum of Art, Toledo, Ohio; Pennsylvania Museum, Philadelphia, Pa.; Thayer Collection at University of Kansas, Lawrence, Kan.; Weaver Collection at North Texas State Teachers College, Denton, Tex. In England the Victoria and Albert Museum has a splendid collection.

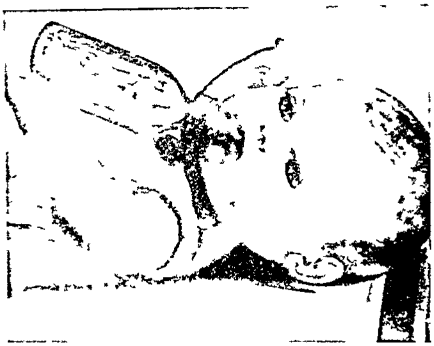
Almost Endless Variety of Dolls

Large American department stores offer scores of different type dolls, ranging from miniatures less than an inch high to life size. They include dolls that walk, talk, cry, smile, blow bubbles, and nibble at your fingers. There are baby dolls, bride dolls, character dolls, storybook dolls, costume dolls, collectors' dolls, and just plain dolls in every stage from diapers to evening dress and fur capes.

The modern walking and talking dolls have a long line of "ancestors." As early as 1862 E. R. Morrison of New York patented a walking doll, and within a few years there were several other models. In the 1890's Thomas Edison developed a "phonograph doll" that "said" nursery rhymes; other inventors soon produced dolls that sang or said their prayers. Mechanical dolls, fitted with tiny music boxes, appeared very early in the 19th century in Europe.

Until the first World War almost all American dolls were imported, chiefly from Germany and Japan. When the war cut off the German supply, American manufacture quickly expanded. Today the United States makes more dolls than any other nation, but still imports a great number, chiefly from Italy, France, United Kingdom, and again from Germany and Japan.

TWO FAVORITES OF OLDER CHILDREN



Few dolls made such toy history as Dy-Dee doll. A few minutes after this one finishes the water in its bottle, it will have to be "changed." It was the first doll to introduce "baby care" into a child's play life. Right, a "little mother" learns hair care by shampooing her doll's synthetic locks.

The first popular American-made doll was *Billiken*, which came out in 1908. In 1909 came the merry *Kewpie*. Other models that made American doll history include *Bye-Lo Baby* (1924), which Grace Putnam Storey modeled after a baby only three days old; *Patsy* (1926), the first doll with a wardrobe; *Dy-Dee Baby* (1932), the first infantlike doll to drink and wet; *Shirley Temple* (1934), the first great "person doll"; the *Magic Skin Baby* (1946), first with texture resembling human flesh. Today doll manufacturers compete so keenly that dozens of new models appear yearly.

What Dolls Are Made of

Dolls can be made from practically anything—from whalebone to nylon. The materials most used in dolls made in America are rubber, cotton, rayon, oilcloth, felt, paper, and composition. Most of them are composition, which was developed in the 1920's. It is a mixture of resin, wood flour, starch, and water packed into molds, pressed, and baked. Composition dolls are virtually unbreakable. Many have plastic "skin" that warms to the touch, wrinkles, and feels much like human flesh. Some have synthetic hair, with each piece individually united to the head, that can be washed and "permanent-waved."

Many children like homemade dolls, and a number of schools encourage their classes to make dolls in historic or foreign costumes. Stocking dolls, rag dolls, and paper dolls are favorite, easy-to-make dolls.

Dolls in Other Lands

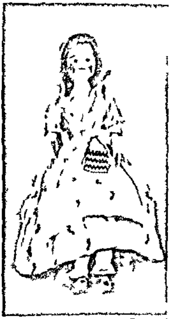
Dolls are said to be the most popular of all toys. Children all over the world love them. Most children in other lands are happy with very plain little dolls. A Korean girl makes a doll from a length of bamboo, stuffing grass into the top for hair. Eskimo youngsters treasure carved bits of whalebone or walrus tusk and skin dolls stuffed with fur. In Mexico girls play with rag, wood, or clay dolls.

Brazilian children enjoy dolls made of yarn wrapped around wire. In Africa little girls cherish bits of wood with clumsily carved features. Swedish children make dolls of birchbark. In India bazaars sell stuffed cloth dolls dressed with turbans or saris; cheaper dolls

Continued on page 122e

DOLLS IN THE MUSEUM OF THE CITY OF NEW YORK

This rare Peddler doll, or Vendor doll stands 14½ inches high. Her head and hair are china. She was made about 1860



She came from Holland in 1805. Her wood body is jointed. Her hair is real. She wears clothes made for her about 1844

The wax doll smiles demurely. She has real blonde hair. Her bootees are crocheted. She dates from about 1840

The stuffed rag doll rests in his toy wicker chair. He stands 16 inches high. He first delighted some child about 1880

Her head and hair are bisque. When her bisque hands broke she got cotton ones. Made about 1840. She is 15 inches high

The lovely costume dolls shown on these two pages are imported. Their historic dress is representative of their native countries or regions. Even today, where people have adopted less colorful dress for work, many persons still appear in costumes like these on fete days. The detailed and careful handwork on these beautiful dolls reflects the skilled handicraft that is still practiced in many parts of the Old World and of the Far East. These dolls were provided by Marshall Field and Company, Chicago, Ill. They were especially photographed in their original colors by the Compton art staff.

GREECE

SLAVIC

BRITTANY

BALI

ALBANIA

INDIA

JAPAN

CHINA

The imported dolls shown on these two pages vary in actual size The Japanese male actor doll stands on y 7 inches high. The Spanish dancer on the oppos te page is near y 18 inches high The Bali dancer figurine which was made by an American after much study is only 5 inches tall *The beauty and significance* of these dolls make them "collectors items Their prices range from a few dollars to hundreds The Br t tany dolls are unique They recall an old Breton legend. Ages ago an evil w ch sna ched newborn bab es When a brave mother released them she dressed them all in festive finery

COSTUME DOLLS IN MINIATURE AND IN PAPER

The rich hues and lavish embroideries of old China brighten the dress of the mandarin doll couple, right, and their attendants.

The dainty ladies above are shown in actual size in tiny glass domes. They are done in the style of the old-time fashion dolls.

The doll replica of Jane Seymour, third wife of Henry VIII, wears a bell-like canvas underskirt—forerunner of the hoop.

This Henry VIII doll shows the splendor of the nobles' dress in 16th-century England. The waistcoat is richly embroidered.

The young Queen Victoria doll is resplendent in an exact reproduction of the coronation regalia worn June 28, 1838.

These paper dolls were more than playthings. They were exhibited to display high fashion in the United States about 1866. In the center stands a fashion magazine, *The American Lady and Her Children*. Americans followed European styles.

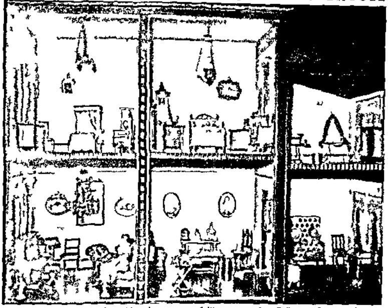
are crudely carved bits of wood painted on one side and wearing a beauty spot on the forehead

Japanese girls have inexpensive dolls for daily play but every home tries to have a set of beautifully costumed dolls for the Dolls Festival *Hinamacuria* on March 3 On that day the family sets up a series of shelves one above the other and arranges on them ceremonial dolls collected since the girl s birth (For picture *see* the article Japan)

Strange History of Dolls

Children have probably always loved dolls but dolls also had religious significance in ancient times Doll like figures go back to prehistoric times Some scientists think they were not playthings but believe that the little images found in Stone Age caves were carved as charms and fetishes or ritual images Doll like figures found in tombs of ancient Egypt are thought to represent not toys but servants—substitutes for real servants who were formerly buried alive with the bodies of their masters Tombs of wealthy ancient Egyptians held toy furnishings and tiny carved figures representing every kind of work—rowing farming cooking music making Early Greek and Roman dolls are considered to be religious offerings and portrait statuettes buried with children These little figures made of ivory or terra cotta had jointed limbs and resembled modern dolls In later Roman days girls received dolls on December 17 the

TIME HAS NOT DIMMED THIS QUAINT DOLLHOUSE



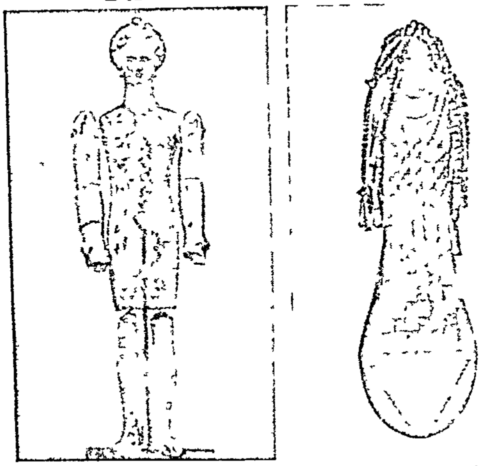
The ornate furniture of the mid 19th century equips this dollhouse Notice the simple washing facilities upper right A famous dollhouse is the Colleen Moore Dollhouse in the Museum of Science and Industry Chicago Ill Dollhouses can be homemade too

AT THEIR BEGINNING—AND A SECOND START

In modern American factories dolls are made on assembly lines If the dolls are made of composition as most are the parts are molded separately The hair goes on last to save wear

In the days when dolls were made of china bisque or wax a good bump usually broke them beyond repair Today doll hospitals skillfully repair the casualties and give the dolls new life

EARLY DOLLS FROM THE OLD WORLD AND THE NEW



At the left is one of the oldest dolls preserved. It was found in a tomb at Sakkara, Egypt, dating from about 2000 B.C. Right, is an Egyptian paddle doll with hair of clay beads.

Above are two cornhusk dolls made by Seneca Indians in the latter part of the 19th century. At first, Indian cornhusk dolls were made as fetishes. Indians also made wooden dolls.

festival of Saturnalia. On reaching maturity a Roman girl presented all her dolls, and other symbols of childhood, on the altar of the goddess Diana.

The Pueblo Indians of America attached religious significance to their *kachina* dolls. Children received them to learn about tribal rites and spirits. (For pictures, *see* Indians, American.)

Fashion Dolls Become the Vogue

In the latter part of the 14th century men and women began to use dolls to show the latest fashions in dress, millinery, and hair styles. France was the style center. In 1391 the King of France sent a group of fashion dolls to the Queen of England to show her the latest French court styles. Early in the 17th century Henry IV of France wrote to his fiancée, Marie de' Medici: "Frontenac tells me that you wish to have samples of our fashions; I am therefore sending you several model dolls."

Later both France and England shipped fashion dolls to India and the American Colonies. They were also called "fashion babies" and took the place of the modern fashion magazines.

In the 18th century jointed cardboard puppets became popular in France. Men, women, and children played with them even on the street. The very rich enjoyed elaborate ones designed by court painters. Some cost as much as $7,500 each.

Dolls Become Children's Playthings

Dollmaking for children began as an industry about 1800. For about a century most dolls represented grown women. Most of them were rag dolls or were made of wood, china, leather, or wax. Germany was the center of the china-doll industry, and about nine tenths of the rosy-cheeked china dolls had black hair and blue eyes.

England made the best wax dolls. Some heads bore human hair, set in one strand at a time. Their eyes were made of glass and china. About 1825 the English began to insert eyes that moved. Some of the wax dolls had heads of *bisque*, an unglazed and hard-fired pottery. Germany made nearly all the bisque heads until the Jumeau family in France produced beautiful models about 1862. Another famed French maker of dolls with bisque heads and wooden or kid bodies was M. Bru. Dresden, Germany, led in the production of Parian heads, so called because many of the bisques were colorless—"as white as Parian marble."

Not until the 20th century did manufacturers make dolls in the likeness of real little children and babies. The word *doll* is a pet nickname for "Dorothy" and was used to mean "little thing." It was first used to mean "doll" about 1700. (*See also* Toys.)

DOLPHIN. Every ocean traveler is familiar with dolphins, the small relatives of the whale. They escort steamers for miles across the sea, apparently delighting to leap from the water and to exhibit their swimming tricks to human spectators. Probably because of their friendliness, no creatures of the ocean have ever been surrounded with more myth and romance (*see* Arion). It is a sailor's superstition that bad luck will come to anyone who harms one of these sea clowns. When the churning propeller of a steamer cuts up an inexperienced young dolphin, the old "salts" shake their heads in warning.

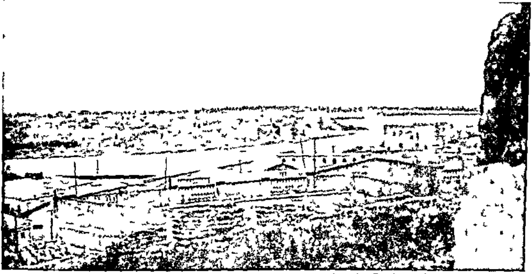
The dolphin is frequently mistaken for the porpoise. The "schools of porpoises" described by many seafarers are in reality dolphins, for the true porpoise seldom ventures far from shore (*see* Porpoise). Unlike the porpoise, the dolphin has a sharp beak-like nose, but otherwise these sea mammals resemble each other closely. The common dolphin is six to eight feet long and is dark brown to black above and white to light green underneath. Its slender, sharp-pointed teeth, as many as a hundred in each jaw, suit it for feeding upon fishes. The tail is flattened horizontally, not vertically like that of the fish, and the dolphin has other peculiarities of the whale order. (*See also* Whale.)

Some species swim up the mouths of rivers especially in South America They are not a staple article of food although seamen occasionally defy superstition and catch a dolphin in order to enjoy the rich oily meat

The Greeks used the dolphin as a symbol of the sea and to the early Christians it was a symbol of the dead The name dolphin is also given to a swift fish of the open sea, which often attains a length of six feet They are of a brilliant golden blue with deep blue spots, but the colors fade rapidly when the fish is taken from the water *The scientific name of* the common dolphin (mammal) is *Delphinus delphis*, of common dolphin (fish) *Coryphaena hippurus*

DOMESTIC SCIENCE This name is given to a group of subjects now usually called *Home Economics*, taught in schools and colleges with a view to preparing girls to be homemakers The courses deal with foods and their preparation textiles and other clothing materials household sanitation, and so forth (*See* Home Economics)

The DOMINICAN REPUBLIC *Where Columbus Once* RULED



From the crumbling wall of the old city of Santo Domingo (now called Ciudad Trujillo) we look down on the mouth of the Ozama River where Columbus moored his storm tossed ship to a tree In the background on the right can be seen the castle built for his son Diego, who ruled the island after his father's death.

DOMINICAN REPUBLIC Between Cuba on the west and Puerto Rico on the east lies Hispaniola the second largest island of the West Indies Two nations share the island Haiti occupies the western third (*see* Haiti), the rest is under the flag of the Dominican Republic formerly called Santo Domingo The Republic covers 19 325 square miles—about half the area of the state of Ohio Its shores are washed on the north by the Atlantic Ocean and on the south by the Caribbean Sea (For map *see* West Indies)

Four thickly wooded mountain ranges cross the country from west to east The highest and longest is the central range, dividing the country in two Here Pico Trujillo the highest peak in the West Indies rises to over 10 000 feet (authorities vary as to the exact height and some report Monte Tina to the southeast as higher) Between this range and the coastal mountains to the north spreads a broad valley, the Cibao, richest farm section of the country Other farmlands are on the broad plain south of the central range In the southwest corner of the republic are two short ranges, enclosing Lake Enriquillo, a salty body of water 163 feet below sea level

The Dominican Republic lies in the tropics, but the heat is tempered by ocean breezes and the temperature seldom rises above 90° F There are only two seasons—rainy from May to November dry, from November to May Trade winds from the northeast bring abundant moisture to regions lying to the windward side of the mountains (*see* West Indies) The west and south are dry, with some deserts and most of the farms here depend on irrigation

The Products and the People

Like its island neighbors the Dominican Republic looks chiefly to sugar for its livelihood Sugar and molasses account for more than half of the nation's income from exports Cacao and coffee rank next in importance Cassava (for tapioca) rice, corn and plantains are also grown, chiefly for home consumption Cattle are raised in increasing numbers and hides are exported The country's rich timber resources are largely inaccessible, but some lignum vitae and other hardwoods are exported Mineral resources are little developed

The Dominican Republic has about two thirds as many people as its crowded little neighbor Haiti The

majority of the people are of mixed Negro and white blood. The original Indian population has disappeared. Most of the people live in palm-thatched huts in small rural villages.

once the residence of the Columbus family. In 1930 a hurricane destroyed nearly all the city but spared the massive structures of colonial days. Under President Trujillo, the city was rebuilt, and in 1936 was renamed in his honor Population (1950 census, 181,553).

THE OLDEST CATHEDRAL IN THE AMERICAS

Behind this statue of Columbus is the aged Cathedral of Santo Domingo. It stands in the old city of Santo Domingo, which is now called Ciudad Trujillo. The cathedral's solid stone walls have withstood wars and hurricanes. The interior has been restored since the days when Diego, son of the great explorer, worshiped here. The remains of Columbus were brought to this cathedral from Spain for burial.

The Country's Troubled History

Columbus discovered the island of Hispaniola on his first voyage and left a garrison on the east coast. This settlement was wiped out by the Indians, and when Columbus returned the next year he established a second colony, called Isabella, which he left in charge of his brother Bartholomew. When he revisited the island in 1498 the colonists had built a fort on the south coast and founded the town of Santo Domingo, named for the patron saint of Columbus' father. Epidemics and the hardships of forced labor rapidly reduced the Indian population, and slaves from Africa were brought in to work on the rich plantations (*see* Las Casas). For more than a century Spanish rule was undisturbed. Then the French began to colonize the western shore, and by 1795 France had extended its sway over the entire island. In the early 19th century the Haitian Negroes ousted the French and brought the whole island under their rule. In 1814 Spain again acquired control over the western end, but Haiti remained independent (*see* Haiti).

The Dominicans expelled their Spanish governor in 1821, only to fall under despotic Haitian rule again a year later. In 1844 they finally gained their independence. But they were fearful of foreign invasion as well as of the Haitians; and in 1861 they appealed to Spain to be reannexed. Two years later they again rebelled and the Spanish withdrew for the last time. The republic then asked for the protection of the United States. President Grant was in favor of annexation, but Congress rejected the petition.

For many years the republic suffered from revolutions and corrupt government. Debts were contracted recklessly and foreign governments threatened forcible

Many miles of good roads have been built, but most of the country can still be reached only by horseback. There are several good natural harbors, but the numerous rivers that tumble down from the mountains are navigable only for short distances.

The Oldest European City in the Americas

The chief point of interest in the republic is the old seaport capital Ciudad Trujillo (formerly called Santo Domingo), on the south coast. Founded in 1496 by Bartholomew Columbus, brother of Christopher, it is the oldest surviving European settlement in the Americas, and for a long time was the center of Spanish influence in the New World. Here are the University of St. Thomas Aquinas, which was established soon after the discovery of the island, and the University of Santo Domingo, founded in 1558. Here also stands the famous Cathedral of Santo Domingo, the first in the New World, which was begun in 1523 and completed 18 years later. The remains of Christopher Columbus are believed by many to be interred in this cathedral (*see* Columbus, Christopher). Other historic buildings include Columbus Castle, built 1510–14,

measures to secure payment The republic again turned to the United States for help A fiscal treaty was signed, and in 1905 the United States took over the collection of customs, setting aside part of the revenue for the payment of debts

Revolts continued and further indebtedness was incurred in violation of the treaty In 1916 the United States sent marines to occupy the city of Santo Domingo The revolutionary forces were quickly subdued and a military government established Towns were cleaned up schools built, and roads and public works constructed The Dominicans however never ceased to protest against the occupation and in 1924 the United States removed its troops After a period of unrest a strong government was finally established In 1941 the United States discontinued its supervision of the customs The republic has a president and legislature elected by popular vote Population (1950 census), 2 135 872

DOR'MOUSE This small animal of squirrel-like habits, a native of the Old World is related to both the mice and the squirrels and is in structure intermediate between them It lives in trees and bushes feeding on nuts and berries and sits erect on its haunches like a squirrel when eating It lays up a store of food for winter, and when cold weather comes it curls up in its nest and sleeps On warm days it is likely to wake eat and fall asleep again Its name means "sleeping mouse" Dormice are tamed and kept as pets In the United States the common white-footed mouse is often called dormouse

DOUGLAS, STEPHEN ARNOLD (1813–1861) Though a New Englander by birth, having been born at Brandon, Vt, Stephen A Douglas early identified himself with the new West and for a time was regarded by the slaveholding South as its most promising champion At the age of 20 he moved to Illinois and there began the practice of law Politics soon claimed his attention, and from 1835 until his death he held office, either in the state government or in Congress

It was in the United States Senate that he won his chief fame as author of the Kansas-Nebraska Bill of 1854 This gave popular (or "squatter) sovereignty to these territories, that is, provided that the people of each should themselves decide whether the territory should come into the Union as a slave or free state The bill was opposed by the antislavery leaders for however they might differ as to what should be done with slavery where it already existed they were all opposed to its further spread Among these was Abraham Lincoln who in 1858 ran against Douglas for the senatorship from Illinois basing his campaign largely on the Kansas Nebraska issue

The series of joint debates in which Lincoln and Douglas engaged attracted the attention of the whole country Douglas won the prize of the senatorship but in the debate at Freeport Ill he was led to declare that any territory could by 'unfriendly legislation" exclude slavery (See Lincoln-Douglas Debates) This statement so antagonized the South that when the National Democratic Convention met in 1860 the Southern delegates "bolted" rather than support Douglas for president and named John C Breckinridge in a separate convention as their candidate The Northern Democrats nominated Douglas The split in the party made the election of Lincoln, the Republican candidate, a foregone conclusion

Douglas now devoted his energy to opposing secession and loyally pledged his support to Lincoln and the Union Unfortunately this valuable work was cut short by his death from typhoid fever less than two months after the beginning of the war Douglas left a reputation as a formidable debater powerful orator, and resourceful political leader Because of the contrast of his small body—he was barely five feet in height—with his massive head and shoulders, he was known as the Little Giant"

DOVER, DEL. About Dover's pleasant, elm-shaded Green stand the State House and many other colonial type office buildings and homes In 1683 William Penn ordered that a new county seat be established here A courthouse and prison were built before 1697 but the town was not laid out until 1717 In 1777 Dover replaced New Castle as the capital of Delaware

Dover is situated on the St Jones River and a widening of the river called Silver Lake about 35 miles south of Wilmington The countryside is fertile, and Dover ships much farm produce Several canning and packing plants are here The manufactures include building materials paints and latex products

The present State House was built between 1787 and 1792 as a county courthouse and a state capitol It served both purposes until 1873 when the Kent County courthouse was erected Several additions have not spoiled the colonial charm of the State House The Delaware State Museum was built as a church in 1790 Other fine old colonial buildings on or near the Green are Christ Church and the Ridgely House Legislative Hall, to the east of the Green, was completed in 1933

Near Dover is Delaware State College established for Negroes in 1891 Wesley Junior College lies within the city Dover's city-owned utilities include an electric plant Its government is a modified city-manager form (See also Delaware) Population (1950 census) 6 223

DOVER, ENGLAND To Englishmen returning from travels on the European continent the "chalk cliffs of Dover" have for centuries signified home To continental nations seeking to invade England these white cliffs are the path of conquest, for this great port on the English Channel is separated from France at Calais, by only 21 miles On bright days the French coast is visible across the Strait of Dover

The city's long role in history is attested by its great castle towering on the cliffs 375 feet above the sea This grim old building was used as a fortress in Norman times and with modifications, it is still a bulwark for the defense of these shores Within its walls is a lighthouse dating from the Roman occupation of Britain The city fought off the French in the

naval battle of Dover (1217). In the first World War it was a submarine base. In the second World War, from August 1940 to September 1944 it was first bombarded by planes and later shelled by long-range German guns emplaced on the coast of France.

Dover lies at the mouth of the little Dour River, whose valley cuts through the chalk cliffs of the coast. The harbor, which has been improved, is one of the finest on the east coast. Normally, the city is the terminus for passenger vessels from Calais and Ostend. Shipbuilding is the city's major industry. Population (1951 census, preliminary), 35,217.

Dragon. Long ago, according to a legend of the Middle Ages, there dwelt in a distant pagan land a dreadful monster called a dragon. The flapping of its great batlike wings could be heard for miles around, and with a single blow of its terrible claws it could fell an ox. Its snakelike body was covered with slimy scales and on the tip of its pointed tail was a poisonous sting. From flaring nostrils came clouds of smoke and flame that brought death to those who breathed it.

Every year a young virgin was offered to it to prevent it from rushing upon the city and destroying all the inhabitants. One year the lot fell on Princess Sabra, daughter of the king; but she was saved by the valiant Saint George, youngest and bravest of the seven champions of Christendom, who chanced to be riding in this far-off land in search of adventure. With his magic sword Ascalon, he wounded the monster so sorely that the princess was able to put her sash about its head and lead it, meek as any lamb, to the market-place of the town, where Saint George slew it with one blow. Won over to the Christian faith by this deed of its champion, the people were baptized, and the Princess was wedded to her deliverer.

This is but one of the many dragon stories told in the lore of different countries (*see* Perseus; Siegfried). Before the time of Columbus and the age of discovery sailors refused to venture into unknown seas for fear of encountering dragons and other monsters of the deep. Old maps show the unchartered seas filled with strange creatures having wings, horns, and claws of such enormous size that they could crush a ship. The dragons of Chinese and Japanese myth and art are reptiles with batlike wings and claws and are supposed to spread disease and death among the people. Sacrifices are still made to appease their wrath. For ages the dragon was the emblem of the former imperial house of China.

That these superstitions have a basis of fact is perhaps indicated by the discovery of fossil skeletons of mammoth reptiles that roamed the prehistoric world. Although the most terrifying beasts of prehistoric times, such as the dinosaurs, lived in the ages before man had appeared on earth, there may have been some surviving reptiles of great size in the time of the primitive cavemen of Europe. Such beasts would easily give rise to legends of monsters such as the dragons. (*See* Reptiles.)

In the East Indies certain small lizards, seven or eight inches long, are known as "dragons." They are about the color of tree bark, and the skin along their sides between the legs spreads out into a kind of parachute, enabling them to fly among the branches of the trees in which they live. There are about 20 species, all of them harmless.

A MODERN DRAGON OF THE WEST INDIES

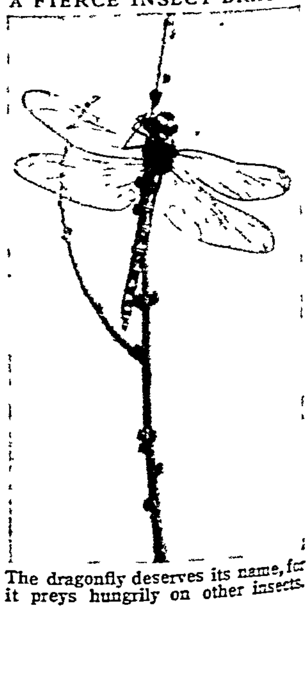
The terrifying rhinoceros iguana of Haiti and Puerto Rico might well have inspired some of the tales of man-eating dragons.

Dragonfly. Some fine summer day you may see a thick, clumsy insect crawl out of a pond. Slowly it climbs up a plant. It rests a few moments. Suddenly its muddy coat splits down the back. Now a light slender creature works its way out. At first it is too weak to open its wet wings. It warms itself in the sun. The four wings dry, and then it zooms into the air. Another beautiful dragonfly has come into the world.

Some people fear these quick-darting gems of the air. They call them "snake feeders," "horse stingers," and "devil's-darning-needles." They tell children the flies will sew up their ears. Actually dragonflies are very useful. They eat thousands of mosquitoes, flies, and other insects harmful to man.

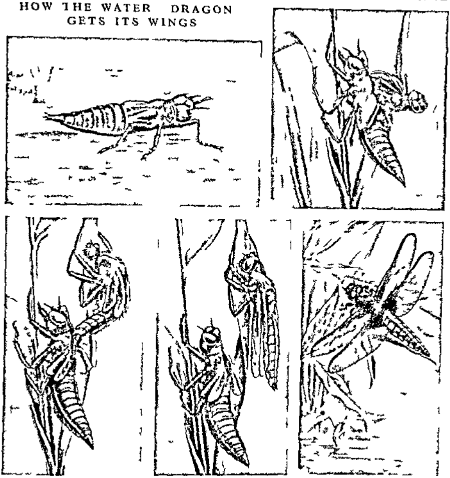
We can recognize a dragonfly easily as it dips down over pond and stream, meadow and lawn, looking for food. The beautifully veined, silvery wings may be two to five inches long. The body is about three inches long, highly colored in steel blue, purple, green, or copper. Its six legs are far forward and close together. The

A FIERCE INSECT DRAGON



The dragonfly deserves its name, for it preys hungrily on other insects.

HOW THE WATER DRAGON GETS ITS WINGS



In the upper left picture is a dragonfly nymph a thick bod ed creature that craw s through the mud of pond bottoms At the upper right it has climbed up a plant stem into the air The skin has spl t open and the adult insect is just beginning to work i s way out In the next two pictures it has freed itself of the cast skin It rests for a time while the wings dry and expand At last it flies off and one of the ug iest insects has been transformed into one of the most beautiful.

dragonfly can curve its legs into a basket It uses the basket to scoop insects from the air Then it puts them into its jaws These jaws have strong teeth If you catch tl e fl es your fingers may get nipped

Two great eyes cover most of the head Each eye has from 20 000 to 25 000 tiny eyes jo ned together With these b g eyes it can see its prey easily

There are two large groups of these insects—the dragonflies themselves and the damsel flies The dragonfly darts with the speed of an express train Some can fly 60 miles an hour The two rear wings are larger than the front pa r They are held outspread when the insect lands The damsel fly is more slender It flies more slowly and lazily The wings are the same size When the insect rests the wings come together over the back like a butterfly s

The dragonfly begins life as a water insect Tl en we call it a nymph The mother lays her eggs in the water As she fl ts over the pond aga n and again she dips underwater to wash off the eggs Some spec es lay the r eggs in long str ngs on water plants Such a string may have 100 000 eggs

The damsel fly cuts a sl t in the stems of water plants Then she puts her eggs in the opening She uses a part of her body called an *ovipositor* to do this (The word ovipos tor means egg depositor) Sometimes the damsel fly goes under water and walks about looking for a good cradle The male may go with the female on this trip

The nymphs hatch out of the eggs in one to four weeks They are half an inch to nearly two inches long They are flat dark creatures and have long legs They hide under rocks and in the mud There they wa t to jump on a careless insect or even a small fish These nymphs are as fierce in the water as the grown fl es are in the air They have a strange way of catching their prey Their underlip has

joints. It is very long, with a pair of hooks at the tip. They shoot this lip forward and catch the insect on the hooks. When they are not using the underlip they fold it over the face like a mask.

The dragonfly nymph breathes by drawing water into the back part of its intestine. Tiny air tubes take out the oxygen. The nymph then pushes out the water in quick spurts. In this way it drives itself forward, like a jet-propelled airplane. The damsel-fly nymph has three leaflike gills at the end of its body. These gills take in oxygen from the water.

As the nymphs grow they shed their skins 10 to 15 times. They live one to four years as nymphs, depending on the species. In the winter they sleep in the stream bed. Adult dragonflies live only a few months.

Dragonflies are members of the order *Odonata.* The dragonflies proper belong to the suborder *Anisoptera* (from two Greek words meaning "unequal wings"). The damsel flies belong to the suborder *Zygoptera* ("yoke wings"). There are about 2,500 species scattered over the world. North America has about 300 species. One common dragonfly is known as the mosquito hawk (*Anax junius*). It is a bright green, with clear wings about two inches long. The "ten spot skimmer" (*Libellula pulchella*) has three blackish-brown and two white spots on each wing. Only the male has the white spots. The ruby-spot (*Hetaerina americana*) is a common damsel fly. Its head and upper body are coppery red. The abdomen is green. The male has a ruby-red spot at the base of the wings. In the female the wing is yellowish brown. The black-wing (*Calopteryx maculata*) is also common.

DRAKE, SIR FRANCIS (1545–1596). Of all the great sailors in the reign of Queen Elizabeth I the most famous was the bold buccaneer Sir Francis Drake. He was the first Englishman to sail round the world and he took a leading part in defeating the Great Armada sent by Spain to invade England.

Born near Tavistock, in Devonshire, Drake grew up in a seafaring atmosphere. While still a boy he shipped as an apprentice on a coasting vessel. When he was 20, he sailed with his cousin, Sir John Hawkins, on a slaving voyage to Guinea, on the west coast of Africa. He rose to command a ship under Hawkins and was with him when Spaniards attacked the fleet off the port of Vera Cruz, in Mexico. All but two of the English ships were destroyed in this battle, and Drake lost nearly everything he possessed (*see* Hawkins). Drake never forgave the Spanish for their treachery on this occasion or for their cruel treatment of their English prisoners. He devoted the rest of his life to a relentless war against Spain.

Drake gathered together his own band of adventurers and made three profitable voyages to the New World, plundering Spanish settlements and destroying Spanish ships. In 1572 he made a daring march across the Isthmus of Panama. From a high tree he caught his first glimpse of the Pacific and prayed that he might sail upon that sea. His prayer was answered five years later, when he sailed round the world.

WHEN DRAKE FIRST SAW THE PACIFIC

Sir Francis Drake's first glimpse of the Pacific was when he climbed a tree in which his Indian guide had cut steps for him. When he saw it, Drake prayed to God that he might "sail once in an English ship on that sea."

This great voyage (1577–80) had the secret financial support of Queen Elizabeth I and the war party in her council because they hoped it would end Spanish monopoly of the profitable trade in the Pacific. Drake set out with five ships. He intended to pass through the Strait of Magellan, near the southern extremity of South America, and then explore the waters he had seen from the Isthmus of Panama. When the straits were passed, Drake's ship, the *Golden Hind,* pushed on alone, the other vessels having either turned back or been lost. Up the coast he went, plundering Spanish settlements in Chile and Peru with impunity and capturing unsuspecting treasure ships bound for Panama.

Drake then sailed northward and claimed the California coast in the name of his queen. To avoid meeting the aroused Spaniards by returning the way he came, he determined to return home by sailing around the world, as Ferdinand Magellan had done; so he crossed the Pacific and Indian oceans and reached the Atlantic by sailing around the southern tip of Africa. (For map showing route, *see* Magellan.) He reached England in November 1580, nearly three years

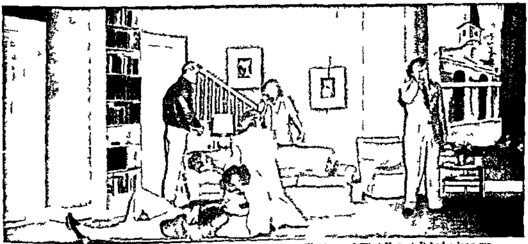
after he set out. He was warmly acclaimed. Elizabeth shared richly in the treasure he brought (his ship was "literally ballasted with silver"). She honored him by dining on board his ship and by raising him to knighthood, although she knew this would infuriate the Spaniards.

In the war with Spain that broke out soon after (1585) Drake won his crowning honors. After once more carrying death and destruction to Spanish settlements in the West Indies, he led a daring expedition into the port of Cadiz, Spain itself. Here he destroyed so many vessels that for a whole year the Spaniards had to delay the expedition they were preparing for the invasion of England. After thus "singeing the king of Spain's beard," Drake returned home in triumph.

When the Spanish Armada finally did come sailing up the English Channel in 1588, Drake, as vice admiral of the English fleet, played a chief part in the week-long running fight that drove off the Spaniards (*see* Armada, Spanish). During this fight Drake encountered a fine galleon commanded by Don Pedro de Valdez. Don Pedro was one of the leading promoters of the idea of dispatching the Armada to England. Yet when he and his men learned that their opponent was the daring El Draque ("the dragon") they surrendered at once.

Some eight years later, on a final expedition against the Spaniards in the West Indies, Drake was taken ill and died on board his ship in January 1596. Perhaps more than any other of England's bold privateers he had helped to break down the commercial and maritime supremacy of Spain and to set England on the way to becoming mistress of the seas. A Spanish captain, captured and later released, wrote in a letter this description of the bold commander and of life aboard his ship:

He [Drake] is about 35 years old, of small size, with a reddish beard, and is one of the greatest sailors that exist, both from his skill and his power of commanding. He has with him nine or ten gentlemen, younger sons of the leading men in England, who form his council. He has too all possible luxuries, even to perfumes, many of which he told me were given him by the Queen. None of his gentlemen sits down or puts on his hat in his presence without repeated permission. He dines and sups to the music of violins. He has two draughtsmen who portray the coast in its own colors so naturally that anyone following him will have no difficulty.



Typical of modern stage comedies is "The Male Animal," by James Thurber and Elliot Nugent. It had a long run in New York City, was made into a motion picture, and has been revived often. It is also a popular play for high school dramatic groups. Here a *high-school cast* is involved in one of the high comic moments of the play.

The DRAMA *Through* TWENTY-FIVE CENTURIES

DRAMA. Our modern stage plays—along with motion pictures and television plays—*have their* roots in man's age-old love of putting on a show. Most *early peoples performed in one way or another. The* early Greeks, who contributed so many advances to European civilization, began putting on shows that soon became plays much like those of today.

At planting and harvest time the early *Greeks held* their most important festivals. At these seasons they worshiped Dionysus, the god of the vineyard, of plants and fruitfulness. Gradually their wild processions and chants became more or less fixed in form. *At the* wine festivals in winter, bands of revelers marched through the villages chanting songs. Between songs the leader of the procession exchanged jokes with members of the company or with leaders of rival bands. The best of these jests were repeated from year to year until gradually they became genuine

drama—the representation of a complete story by words and action. From these rude dialogues grew Greek comedy, so called from the Greek words *komos* (revel) and *ode* (song).

The Birth of Tragedy

The spring festivals took a different turn. At these times it early became the custom to tell in song and dance the chief episodes in the life of the god they were worshiping. Dressed in goatskins to represent the satyrs—beings half goat, half man, who attended Dionysus—they would dance around the smoking altar, reciting the god's adventures. From this humble beginning sprang Greek tragedy, a creation of human genius which for moral grandeur, dramatic power, and artistic perfection is equaled only by the greatest works of Shakespeare. Tragedy gets its name from the goat-skins worn by the chorus, being formed from the Greek words *tragos* (goat) and *ode* (song).

It is easy to see how in course of time the leader of the chorus would introduce passages of lively dialogue with the chorus, to amplify and explain the narrative given in the choral odes. To arrive at genuine drama, one step remained to be taken. Semi-dramatic narration must give way to actual impersonation of the god and those who shared in his adventures. This step was taken about the beginning of the 6th century B.C. by Thespis, who is traditionally known as the father of Greek tragedy. His innovation consisted in picking out a member of the chorus to play in turn the parts of all the prominent figures in the legend. This was the birth of true drama. Gradually the dialogues and choruses, at first hit off on the spur of the moment, took literary form. They were carefully worked out before the performance and committed to memory by actor and chorus.

Thus the way was opened for the immortal trio—Aeschylus, Sophocles, and Euripides—who established the drama as one of the noblest forms of literary art, and left the magnificent body of plays from which have sprung all later dramatic literature worthy of the name. Each of these great men further unfolded the resources of the art.

GREEK ACTORS AND THEIR "FALSE FACES"

This picture, from a painting by the French artist, Jean Léon Gérome, shows a group of Greek actors in the dressing room of their theater. One of them is holding before his face a tragic mask, as much as to say: "How would I do in tragedy?" Greek actors used to wear huge masks, representing the general character of the part they were playing. For comic rôles the masks were as grotesque as possible. The mouth openings were always large, to permit the voice to issue freely.

Aeschylus introduced a second actor, thus making it possible to throw all the central incidents of a story into dramatic form. He invented a special costume for these actors, raising their stature by thick wooden soles, clothing them in rich robes, and equipping them with awe-inspiring masks, to lend to them the superhuman dignity befitting the great legendary characters they impersonated. Sophocles went a step further in introducing a third actor and giving the chorus a place of less importance. He thus heightened the dramatic interest. Euripides' great contribution was to "bring drama down from the skies." His predecessors represented the heroes, gods, and great legendary characters in more than life size. Euripides was the first realist in the drama, for he was content to paint men and women as they were, with all their defects and vices. He stripped the veil of idealism from the drama and humanized it, thus opening the way for Shakespeare and the other giants of modern drama.

How Comedy Sprang Up

Parallel with the development of tragedy went on the growth of comedy. From the jesting dialogues of the vintage-festival grew burlesques and parodies, plentifully interspersed with broad jokes directed

against the men and fash ons of the day This is the character of Greek comedy as we see it in the plays of Aristophanes who made it the vehicle of satires and burlesques against the Athenians of his time Thus he ridiculed the philosopher Socrates in The Clouds and in 'The Frogs he directed his keen-edged wit against his fellow-dramatist Eurip des Menander the second great comic dramatist of the Greeks whose work is known to us only in fragments and Latin adaptations refined and elaborated the comedy form and molded it into something like the shape we have in the modern comedy of manners

So great were the achievements of the Greek dramatists that the Romans could only follow in their footsteps Their chief writers of comedy Plautus and Terence and their one great tragic poet Seneca did little but imitate the Greek models Even the scenes of Roman comedy were laid in Athens and the characters had Greek names

Both Plautus and Terence found their chief insp ra tion in Menander Terence was content to translate or at the most adapt Menander s comedies Plautus aiming at a lower type of audience dealt more freely with his originals and made his supposedly Athenian characters act and talk like the Romans of his own day Thus he left for us invaluable pictures of low life in Rome

Among the later Romans drama ran an inglorious course The mixed populace of that time—the dregs of the vast Roman empire—had little mind to the severity of tragedy or the delicate fancy of comedy They preferred the bloody fights of gladiators and combats with wild beasts in the arena and the lewd buffoonery of the variety entertainment which they called the *mime* So the influence of the rising Christian church was naturally thrown against the stage and all its works The theater was condemned and accursed and dramatic literature passed from view for nearly a thousand years

Drama in the Middle Ages

Human nature however, remained the same Deprived of the great body of classical drama the people of the Middle Ages began the tedious process of developing a drama all over again There were two main lines of development The harvest and spring time again were the inspiration of seasonal *festivals* vil *lage games and dances* The may pole dance which is still to be seen in rural England *is a survival of* these sports on the village green.

But the chief source of inspiration was again religion as it was in Greece Drama was employed in the church service itself at Easter and Christmas to bring home in concrete form the birth and the resurrection of Christ Little plays dialogues and pantomimes were devised to represent these and other inci dents in the life of Christ

A SCENE FROM A MEDIEVAL PLAY

The great dramatic entertainments of the M ddle Ages were the Mysteries and M racle Plays in wh ch n dents from relig ous h story were presented Each group of actors had ts own pageant or movable stage which was wheeled from st eet to street wh le the var ous scenes were given over and over aga n until the who e series of scenes had been played at each stopp ng place

The new dramatic art flourished throughout Europe but reached its greatest development in Eng *land After a time* the plays grew to such length that it was found inconvenient to include them in the regular service Other Bible stories were *added with legends* of the saints and the performances were transferred to the churchyard and given in series One play led to another until these Mysteries and Miracle plays as they were called expanded to long cycles The York Cycle includes 48 separate plays Though the subject was always religious the treatment often became broadly farcical as in the celebrated scene in which Noah s wife has to be shoved into the ark

As the plays became more elaborate the church gilds and the gild organizations of artisans assisted in the performances and gradually took them over al together Each gild would make itself responsible for a particular ep sode and construct a float consist ng of a dressing room below and a stage above On church festival days this float was dragged through the streets halting at fixed points while the episode was given over and over again to the various com panies of spectators The costuming was often costly and realistic devils were dressed in yellow and black to suggest the fires of hell These Miracle plays con tinued to be very popular during the later 14th and throughout the 15th century By 1550 however their vogue had passed and they were rarely given (*See* Miracle Plays)

Along with these plays grew up another group—the moralities Instead of using biblical and legendary

characters for heroes and villains, they personified vices and virtues such as hypocrisy, heresy, piety, justice, peace, and truth. One of these plays, called 'Everyman', was recently revived and put on the stage with enormous success.

Into this crude, formless, artless folk-drama the Renaissance, or rebirth of classical learning, suddenly introduced a new inspiration. In the libraries of the monasteries, which were the only considerable storehouses of learning, scholars were beginning to find the old Greek and Roman classics. The union of classical models with the subject-matter of the day produced the beginnings of modern drama.

France, England, and Spain soon developed a vigorous national drama. In Germany, which was divided into small autocratic principalities and city-states and was distracted by religious wars, national ideals were weakening through princely imitations of everything French, and there the drama developed late. Her great dramatists, Schiller and Lessing belong to the 18th century. In England, Marlowe, Ben Jonson, and Shakespeare; in France, Corneille, Racine, and Molière; in Spain, Lope de Vega and Calderon—these are the names that will long endure.

Shakespeare heads the illustrious list. He was the matchless genius, who took the best from all ages and fused it into living, breathing, dramatic art. What Shakespeare did for tragedy and romantic comedy, the great Molière did for the comedy of manners.

After Shakespeare the English theater declined rapidly. There are many scenes of beauty and power in the plays of Beaumont and Fletcher, Massinger, Ford, Middleton, Webster, and others, but all these men fell far below their great predecessor in artistic and moral genius. The opposition of the Puritans to the theater, already pronounced, was deepened into bitter hostility by the merciless satire which the dramatists directed against them. Finally in 1642, immediately after the outbreak of the Civil War, the Puritans closed the theaters and Parliament ordered that all stage-players be treated as rogues.

BACKSTAGE AT A MIRACLE PLAY

Notice that the stage for this medieval play is a crude, movable structure set up in the street. As the Infernal Regions are portrayed to the audience, drums and pans are beaten, horns blown, howls uttered, the "thunder barrel," full of pebbles, is turned vigorously, even small cannon are fired. Leaping devils appear through the smoke and flame of backstage torches. Out front, the audience of townsfolk and rustics was often so frightened that the devils had to interrupt the performance and calm the people with merry jests and clowning.

On the restoration of the licentious Charles II, there was a wild reaction from Puritanism to unrestrained sensuality, both in court and society and on the stage. Comic writers of genuine power, wit, and brilliance—Dryden, Congreve, Wycherley, Farquhar, Vanbrugh, and their contemporaries—poured out a flood of clever immoralities, that were brought to an end by the reawakened conscience of the people and the thunders of the famous pulpit orator *Jeremy Collier*. From that day to the present the breach between the theater and the Puritan spirit has remained, though the revival of genuine literary drama in the last two generations has done much to bridge the gulf.

During the 18th century no new plays of lasting value were brought out on the English stage until the time of Sheridan and Goldsmith. Then comedy once more lifted its head but chastened and purified. It no longer offended good taste or morals and had brilliance of dialogue as well as clever characters and situations. Goldsmith's 'She Stoops to Conquer' and Sheridan's 'The Rivals' and 'The School for Scandal' are still seen.

The 19th Century Awakening

The 19th century, which saw the great struggle for democracy, the Industrial Revolution, inventions, new ideas in science and philosophy, also witnessed, in its latter half, a real awakening of the stage.

Henrik Ibsen was the father of the new drama which reflected the changed thoughts and life of the times. His assaults on hypocrisy and his brilliant technique influenced dramatists the world over. Shaw, the Irish gadfly of the English stage, avoided the heavy-handed seriousness of Bjornson and Brieux and the murky despair of the Russians, Tolstoy, Gorky, Chekhov, and Andreev. By his jibes entertaining and annoying in the best Irish manner, he stimulated thought rather than offered pat solutions of social woes.

The Irish did rather more than their share in the redemption of the English speaking stage from banality through the Celtic literary revival which centered about the Abbey Theater directed by W. B. Yeats and Lady Gregory. The "well made play," as the French called Sardou's type of drama, carefully and tautly constructed, thrived in the hands of Pinero in England and Sudermann in Germany.

The plays of Rostand, Barrie, Maeterlinck, and several of Hauptmann's, on the other hand, turned sharply realistic portrayal to imaginative romanticism, enriched by symbolism.

Most significant for the later writers of the 20th century, however, was the growth of naturalism launched by Strindberg, with Hauptmann outstanding among its brilliant exponents.

Naturalism arose from new conceptions of the importance of heredity and environment in the growth of character. Its heroes were passive, its scenes usually laid in the slums, its themes sordid or brutal. Many theatergoers who had observed beautiful and gay aspects of life were moved to ask what was natural about naturalism. Insofar as the word was not a misnomer, it referred to the naturalness of the lowly characters, the rough language, the background, and to the absence of a neat plot.

THE ENCHANTING 'PETER PAN'

Few modern plays have had such lasting success as Peter Pan. Here we see Maude Adams in the costume of the famous part

Naturalism, and likewise the expressionistic reaction to naturalism, made less headway in France than elsewhere, since the French prefer in the theater smartly phrased discussions of manners, light love affairs, and the doings of a smoothly veneered world. Wit, fancy, sentiment, with now and then a serious touch, pervade the plays of Donnay, Sacha Guitry, Bourdet. More serious were François de Curel, Paul Hervieu, and Henri Bataille, social moralists. Conservative forms of the drama likewise prevailed in Spain, where the perfervid Echegaray, the sentimental Alvarez Quintero brothers, the Barrie-like Martinez Sierra, and the lively and versatile Benavente supplied a stage notable for its charm rather than for its novelty, ideas, or progress.

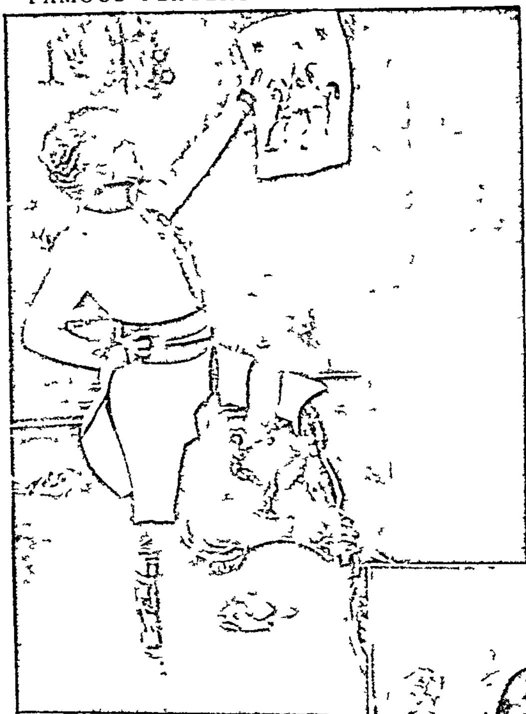
In Italy, however, the stage was enriched by many new ideas. D'Annunzio set off the fires of his colorful voluptuous art. Pirandello made the real world waver in the uncertainty of man's thoughts and dreams. Sem Benelli produced poetic, violent plays, and the poised and subtle Bracco, with faultless technique, achieved the deepest and finest realism.

Original Experiments in Expressionism

The most original experiments, particularly with expressionism, occurred in the war torn countries of Germany and Austria. Expressionism holds that the outside world exists only as an expression or projection of the world of thought and feeling within the human spirit. Galsworthy and Pirandello experimented with this principle, and Oscar Wilde had voiced it long before the term expressionism was invented. But it remained for writers in the Germanic countries to carry it out to its logical conclusion.

Among the best of the expressionists in Germany was Ernst Toller, who had been embittered by his imprisonment for taking part in a revolution in 1919. Anti war themes and revolt against the old social order also inspired Wedekind and Hasenclever, both of expressionistic technique. More eccentric and less

FAMOUS PLAYERS IN FAMOUS RÔLES



Sarah Bernhardt, the great French dramatic actress, is shown at the top in a scene from 'L'Aiglon'. Julia Marlowe and E. H. Sothern appear in the middle in their portrayal of 'Romeo and Juliet'. Below is Joseph Jefferson after his 20-year sleep in 'Rip Van Winkle'. These players represent the romantic school of acting, trained in the 19th century.

talented were Kornfeld, Goering, and Kaiser, weavers of incomprehensible fantasies. Most famous of the expressionist plays was 'R U R' by Čapek, a Czechoslovakian. The Hungarian Molnár, though chiefly known for his romantic comedies, successfully employed expressionism in 'Liliom'. Schnitzler, a witty Viennese, was conventional in technique but shocked his contemporaries because of his daring treatment of love.

Trends in the United States

The chief exponent of expressionism in the United States was Eugene O'Neill 'The Hairy Ape', 'Strange Interlude', and many others of his plays were strikingly original in both technique and subject. Previous American dramatists such as Bronson Howard, William Gillette, James A. Herne, Clyde Fitch, Augustus Thomas, and William Vaughn Moody had treated conventional themes more or less in the European style.

But American playwrights after O'Neill dug deep into the roots of their own country for characters, language, and themes Elmer Rice's 'Street Scene', Maxwell Anderson's 'Winterset', Clifford Odets' 'Awake and Sing', and Sidney Kingsley's 'Dead End' gave simple, realistic expression to social problems. Emphasis on the psychological rather than the social, with a lighter touch and perhaps a greater degree of technical skill, distinguished the plays of Robert Sherwood, Sidney Howard, S. N. Behrman, George S Kaufman, and Philip Barry.

Staging the New Drama

Radical departures were made in staging, lighting, costume, and scenic decorations as directors assumed greater importance in the production of plays Realistic scenery was supplanted by abstract settings, and by beautiful spectacular effects that suggested rather than reproduced literally.

Experiments in the new stagecraft began at the turn of the century. Gordon Craig of England and Adolphe Appia, an Italian-Swiss in Germany, were famous pioneers Max Reinhardt's massive productions introduced rich and grandiose effects well suited to German drama. In the Moscow Art Theater modern techniques were applied by Stanislavsky, Meyerhold, and other Russian innovators.

In the United States, new theatrical ideas were readily absorbed. Lavish musical revues, in which Florenz Ziegfeld pioneered, provided one medium for the development of novel effects in staging and lighting. Among the many leaders in American stagecraft were David Belasco, Robert Edmond Jones, Lee Simonson, Norman Bel Geddes, and Orson Welles. (*See also* Theater)

Alla Na mova and Lionel Atwil n Ibsen s A Doll s House 2 John Barrymo e n the lead ng ó e of John Galsworthy s Justi e 3 Lill an G sh w h emb o dery and Osgood Pe kins n Chekhov s Un e Vanya 4 The husband and wife ting eam of Al ed Lun as Essex and Lynn Fon anne as E ab h n Maxwe l Ande son s *Eli abe h he Queen* 5 *He en* Hayes as the young queen in Lau en e Housman s V oria Regina 6 The d amatic climax o E me R e s S ee S ene

Great Names in the History of the Drama

GREEK

Aeschylus (525–456 B.C.)—'Prometheus Bound'; 'Agamemnon'; 'Choëphori'; 'Eumenides'

Sophocles (496–406 B.C.)—'Antigone'; 'Oedipus Tyrannus'.

Euripides (480–406 B.C.)—'Alcestis'; 'Medea'; 'Bacchae'.

Aristophanes (about 448–385 B.C.)—'The Knights'; 'The Clouds'; 'The Frogs'; 'The Birds'; 'Lysistrata'.

ROMAN

Plautus (254–184 B.C.)—'Amphitruo', 'Captivi' (The Captives); 'Aulularia' (The Pot of Gold).

Terence (about 185–159 B.C.)—'Andria'; 'Heauton Timorumenos' (The Self-Tormentor), 'Phormio'.

Seneca (3 B.C.–65 A.D.)—'Thebais', 'Medea'.

ENGLISH AND IRISH

Christopher Marlowe (1564–1593)—'Tamburlaine'; 'Doctor Faustus'; 'The Jew of Malta'.

William Shakespeare (1564–1616)—'Julius Caesar'; 'Macbeth'; 'Twelfth Night'; 'The Tempest'.

Ben Jonson (1573–1637)—'Every Man in His Humour'; 'The Alchemist'; 'Volpone, or the Fox'.

Francis Beaumont (1584–1616) and **John Fletcher** (1579–1625)—'Philaster'; 'The Maid's Tragedy'.

John Webster (1580?–1625?)—'The Duchess of Malfi'; 'The White Devil'.

John Dryden (1631–1700)—'All for Love'; 'The Spanish Friar'; 'Don Sebastian'.

Oliver Goldsmith (1728–1774)—'She Stoops to Conquer'.

Richard Brinsley Sheridan (1751–1816)—'The Rivals'; 'The School for Scandal'; 'The Critic'.

Henry Arthur Jones (1851–1929)—'Michael and His Lost Angel'; 'The Hypocrites'; 'The Liars'.

Arthur Wing Pinero (1855–1934)—'The Second Mrs. Tanqueray'; 'His House in Order'; 'Mid-Channel'.

Oscar Wilde (1854–1900)—'Lady Windermere's Fan'; 'A Woman of No Importance'; 'The Ideal Husband'.

George Bernard Shaw (1856–1950)—'Man and Superman'; 'Candida'; 'Pygmalion'; 'Saint Joan'.

James Matthew Barrie (1860–1937)—'Peter Pan'; 'The Admirable Crichton'; 'Quality Street'.

William Butler Yeats (1865–1939)—'The Land of Heart's Desire'; 'The Hour Glass'; 'Deirdre'.

John Galsworthy (1867–1933)—'The Silver Box'; 'Strife'; 'Justice'; 'Escape'; 'The Roof'.

John Millington Synge (1871–1909)—'Riders to the Sea'; 'The Playboy of the Western World'.

William Somerset Maugham (1874–)—'Our Betters'; 'The Circle'; 'The Constant Wife'.

Sean O'Casey (1890–)—'Juno and the Paycock'.

Terence Rattigan (1911–)—'O Mistress Mine'; 'The Winslow Boy'.

AMERICAN

David Belasco (1854–1931)—'The Girl of the Golden West'; 'The Return of Peter Grimm'.

Augustus Thomas (1857–1934)—'The Witching Hour'; 'Arizona'; 'As a Man Thinks'; 'The Copperhead'.

Clyde Fitch (1865–1909)—'The Climbers'; 'The Truth'; 'The Girl with the Green Eyes'; 'Beau Brummell'.

Edward Sheldon (1886–1946)—'Salvation Nell'; 'Romance'.

George Kelly (1887–)—'Craig's Wife'; 'The Showoff'.

Eugene O'Neill (1888–1953)—'Emperor Jones'; 'Anna Christie'; 'The Hairy Ape'; 'Desire under the Elms'.

Maxwell Anderson (1888–)—'Elizabeth the Queen'; 'Mary of Scotland'; 'Winterset'; 'High Tor'.

George S. Kaufman (1889–)—'The Royal Family'; 'Stage Door'; 'Dinner at Eight' (with Edna Ferber).

Marc Connelly (1890–)—'The Green Pastures'.

Sidney Howard (1891–1939)—'They Knew What They Wanted'; 'The Silver Cord'; 'Alien Corn'.

Elmer Rice (1892–)—'Street Scene'; 'The Adding Machine'; 'We the People'; 'American Landscape'.

Samuel N. Behrman (1893–)—'The Second Man'; 'Biography'; 'Rain from Heaven'.

Philip Barry (1896–1949)—'Holiday'; 'Animal Kingdom'; 'Hotel Universe'; 'Philadelphia Story'.

Robert Sherwood (1896–)—'Idiot's Delight'; 'The Petrified Forest'; 'Abe Lincoln in Illinois'.

Lillian Hellman (1905–)—'The Children's Hour'; 'The Little Foxes'; 'Watch on the Rhine'.

Clifford Odets (1906–)—'Waiting for Lefty'; 'Awake and Sing'; 'Golden Boy'; 'Clash by Night'.

Tennessee Williams (1914–)—'The Glass Menagerie'; 'Streetcar Named Desire'.

Arthur Miller (1915–)—'Death of a Salesman'.

FRENCH

Pierre Corneille (1606–1684)—'Le Cid'; 'Médée'; 'Polyeucte'; 'Oedipe'; 'Le Menteur' (The Liar).

Jean Racine (1639–1699)—'Bérénice'; 'Phèdre'.

Molière (Jean-Baptiste Poquelin) (1622–1673)—'Tartuffe'; 'Le bourgeois Gentilhomme'.

Pierre Augustin Caron de Beaumarchais (1732–1799)—'Le Barbier de Séville'; 'Le Mariage de Figaro'.

Alexandre Dumas the younger (1824–1895)—'La Dame aux Camélias (The Lady of the Camellias).

Edmond Rostand (1869–1918)—'Cyrano de Bergerac'. 'L'Aiglon'; 'Chantecler'.

Henry Bernstein (1876–1953)—'The Thief'; 'The Claw'; 'Judith'; 'Mélo'.

Sacha Guitry (1885–)—'Deburau'; 'Mozart'.

Jean Paul Sartre (1905–)—'Red Gloves'.

Jean Anouilh (1910–)—'Antigone'.

GERMAN

Johann Wolfgang Goethe (1749–1832)—'Faust'; 'Egmont'; 'Torquato Tasso'; 'Iphigenie auf Tauris'.

Johann Christoph Friedrich Schiller (1759–1805)—'Maria Stuart'; 'Wallenstein'; 'Wilhelm Tell'.

Hermann Sudermann (1857–1928)—'Die Ehre'; 'Heimat'.

Gerhart Hauptmann (1862–1946)—'Die Weber' (The Weavers); 'Die versunkene Glocke' (The Sunken Bell).

Frank Wedekind (1864–1918)—'The Dance of Death'.

Georg Kaiser (1878–)—'From Morn to Midnight'.

Ernst Toller (1893–1939)—'Massemensch'.

SPANISH

Lope de Vega Carpio (1562–1635)—'Los cautivos de Argel'; 'El castigo sin venganza'.

Pedro Calderón de la Barca (1600–1681)—'El Mágico prodigioso'; 'La Vida es sueño'.

Jacinto Benavente y Martínez (1866–)—'La Malquerida' (The Passion Flower); 'Princess Bebé'.

Serafín and Joaquín Alvarez Quintero (1871–1938 and 1873–1944)—'La Consulesa' (The Lady from Alfaqueque).

Gregorio Martínez Sierra (1881–)—'The Kingdom of God'; 'The Road to Happiness'.

ITALIAN

Vittorio Alfieri (1749–1803)—'Merope'; 'Virginia'; 'Saul'.

Gabriele D'Annunzio (1863–1938)—'La Gioconda'; 'Francesca da Rimini'; 'La Figlia d'Jorio'.

Luigi Pirandello (1867–1936)—'Right You Are if You Think You Are'; 'Six Characters in Search of an Author'.

Sem Benelli (1877–1949)—'The Jest'; 'The Love of Three Kings'; 'The Love Thief'.

SCANDINAVIAN

Henrik Ibsen (1828 1906)— The P llars of Soc ety A Dolls House Peer Gynt B and Hedda Gabler
Bjornstjerne Bjo nson (1832 1910 The Gauntlet
August Str ndberg (1849–1912 Ma ter Olof The Father Lucky Pehr To Damascus

RUSSIAN

Leo Tolstoy (1828–1)10)— The Power of Darkness
Anton Pavlov tch Chekhof (1860 1904 The Sea Gull The Cherry Orchard Uncle Vanya
Max m Gorky (1868–1936) The Low r Depths The Ch l ren of the Sun The Barbar ans
Leon d Andréev (18 1 1919 Anathema K ng Hu ger To the Stars He Who Gets S app d

BELGIAN

Maur ce Maeterl nck (1862 1949) Pe léas et Méli sande L Oiseau bleu (The Blue Bird)

CZECHOSLOVAK

Karel Capek (1890 1938)— R U R The World We Live In with Josef Capek The Makropoulos Secret

HUNGARIAN

Ferenc Molnár(1878 1952)— L liom The Guardsman

AUSTRIAN

Franz Gr llparze 1791 1872) The Golden Fleece Sapph The Dream Is a Life
A thur Schn tzler (1862 1931)— Anatol The Lonely Way The Green Cockatoo
Franz Werfel (1890–1945) Goat Song

Degas H la e Germa n Edgar
(1834–1917) French
DANCER BENDING FORWARD
Crayon and pas el 18½ n x 12 n
Art Ins tute of Ch cago
Ch cago Ill

DRAWING

DRAWING The Dancer Bending For ward is a delightful drawing by the French arti t Edgar Degas (*de ga*) It *shows the way n wh ch the artist used* drawing to record the movement of a ballet figure We feel close to the dancer almost as though we were s tt ng on a le el with the stage while the young girl makes her bow We feel the artist s sym pathy w th his subject

Degas was most interested in study ng the postures of the body as seen from un expected angles He especially liked to watch the rehearsals of ballet dancers Looking down on them from some po nt above the stage he sketched their mo t ons as they danced or as they rested and relaxed In th s picture the bend of the body and the rhythmic movement of the upraised arms are the chief concern of the artist Deta ls of the head and face are lost in shadow

Degas s Skillful Choice of Materials

The drawing is done in bla k crayon on blue paper In some areas mauve and chrome-yellow pastel are worked into the figure High lights on the satin sl ppers and on the edges of the arms and shoulders are a glisten ng white Much of the skirt is the unto iched blue of the background paper Wh te lights and a few cr sp dark lines accent the skirt Because pastel and crayon are soft mater als the draw ing g ves the effect of l ving warmth Moreover the soft lines sho v that it is poss ble for an artist to depict an ob je t without sharply defining its edges The gauzy ballet skirt actually looks light and full The taste and sensitivity of Degas s work are due to his skillful

Tiepolo, Giovanni Battista
(1696–1770), Italian
THE REST ON THE FLIGHT INTO EGYPT
Pen and brown wash 16⅝ in x 11⅜ in
Fogg Art Museum, Harvard University, Cambridge, Mass

choice of just the right materials and to the imaginative way in which he makes us see things and feel things, as he has seen and felt them.

Drawing Is a Universal Language

The word "draw" means to drag a pointed instrument such as a pen, pencil, or brush over a smooth surface, leaving behind the marks of its passage. The scribbles of children are drawings as truly as are the sketches of the masters. Children make marks on surfaces long before they learn to write. It is easy to understand, therefore, that drawing is the most fundamental of the arts and is closely related to all the others. Writing itself is simply the drawing of letters, which are symbols for sounds.

Although drawings differ in quality, they have a common purpose—to give visible form to an idea and the artist's feeling about it. As an art form, drawing is the translation of the idea and the emotion into a form that can be seen and felt by others.

The same definition applies to painting (*see* Painting). The difference lies in the materials and in the method used. A painting usually begins to take form as a drawing. The drawing may give a better understanding of the artist's feeling about the subject than the final work. Drawings are often more spontaneous and less labored than paintings. A great drawing not only reveals the technical skill of its creator—it also communicates to the observer the intense emotion of the artist at the time he created his work.

Two Personal Approaches to Drawing

This personal feeling is clearly seen in the work of Giovanni Battista Tiepolo (*tē-ā'pō-lō*), a Venetian who lived in the 18th century. His pen and brown-wash drawing 'The Rest on the Flight into Egypt' shows the artist's light-hearted approach to a serious religious subject. The drawing is full of the sunny brightness found in the work of the Venetians.

Tiepolo achieved his effect through the brilliant handling of the untouched high lights on the figures of Mary, Joseph, and the Child. The swift, curving pen lines, combined with transparent wash and sharp, stabbing dark areas, throw the figures into a dazzling light. The composition is filled with warmth. For the emotional effect he wishes to convey it is not necessary to give detail. His knowledge of space proportion and foreshortening were faultless.

In striking contrast is the wash drawing 'Interior' (next page), by Fernand Léger (*lā-zhā'*), a French artist of the 20th century. Léger composes drawings with mechanical precision. This picture is almost divided vertically through the center. On the left side a figure has been analyzed and drawn in geometric forms. The dark semicircle in the right center foreground is repeated in the arch and in the lines of the steplike construction on the right. The artist organized and executed his design with deliberate care. The planes of the drawing suggest pieces of machinery.

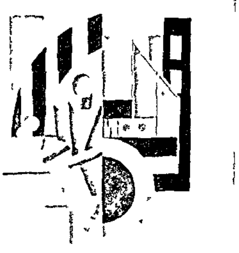
As a follower of the Cubist school of art, Léger reduces natural forms to geometrical shapes. His style permits him to break down objects and reassemble them in his own way to get the effect he wants.

In addition to the way in which they feel about their subjects, artists reflect in their drawings their individual approaches to techniques and tools.

Line Drawings

Pure line is the simplest technical approach to drawing. In *line drawings*, form is usually expressed by line only. There is no attempt to distinguish between light and dark. Master draftsmen have discovered that understatement, or the skillful use of a few lines, has usually resulted in a better drawing. Relative distance forward and backward is frequently achieved by emphasizing the width or depth of certain lines, particularly those closest to the observer.

Line drawing was used in Asiatic, Egyptian, and early Greek art, and its influence can be traced through Byzantine and medieval work, particularly in those areas where the Asiatic influence was strong. Such a drawing is the Persian pen sketch 'Camel with Driver'. In this composition the animal is drawn in rounded outline. Only a few evidences of textural



Léger Fernand
(born 1881) French
INTERIOR
Wash drawing 11 in × 9 in
Galérie Louise Leiris Paris France

treatment are found on its head tail and forelegs The camel driver is treated in the same way

Form Drawings

Form and shadow may be shown in a drawing by means of a series of lines or crossing lines in many different directions Such lines known as hatch and cross hatch lines together with sharply accented high lights were used by such masters as Rembrandt

Most artists have used combinations of line and form techniques The drawings of Michelangelo however represent pure form drawings His Studies for the Libyan Sibyl (on a later page) a superb drawing in red chalk stresses the modeling of the figure Notice the powerful handling of the muscles of the back and arms shown in broad masses This drawing makes one feel the roundness of the figure

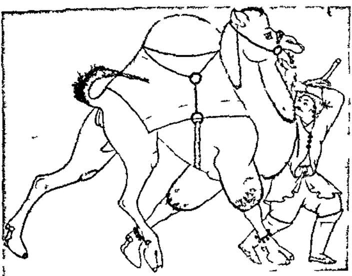
Perspective and foreshortening have been used by some artists to give depth to their drawings Objects in the distance usually are made smaller and the receding edges of forms seem to converge at one or more vanishing points (*see* Perspective) Other artists abstract the essential features of a form without in any way representing it in an imitative style Still others use drawing to produce emotional effects Short jagged lines might indicate intense anger broad curves might signify contentment

The Tools of Drawing

The character of a drawing is also conditioned by the tools the artist uses in its development and by the material on which he draws Most drawings are done on paper which may vary in weight surface texture and color Smooth papers are usually used for fine pen and pencil drawings Rough surfaces are desirable for dry brush drawings As we have observed in the Dancer Bending Forward colored papers may be used to give tonal background to a chalk or charcoal sketch

Pen and *ink* have been used by artists since ancient times During the Middle Ages the quill pen was popular Drawing pens of varying width are widely used by artists of modern times Black India ink and other kinds and colors are used today The Chinese liked to use brush and ink and this combination is still common

Pencils did not come into general use until after 1800 Now many different sizes and shapes together with a wide range of hard and soft lead are available *Chalk* and *charcoal* were known to the artists of ancient times Both can be rubbed into the surface of a paper in developing tonal effects as we have seen in the drawings of Degas and Michelangelo They are limited in use because they smear easily *Crayons*



CAMEL WITH DRIVER
16th century Persian
Pen drawing

Prehistoric Caves.
30,000 to 17,000 B C.
THE STAG FRIEZE. 15 ft. x 3 ft.
From 'The Lascaux Cave Paintings', by Fernand Windels. Viking Press.

have the advantage of color. *Pastel* colors are made of finely ground crayon pigment with a small quantity of gum or resin to hold the particles together. Pastel allows soft effects in a full range of colors

Original drawings may usually be seen only in museums and art galleries. They are known to the public chiefly through *prints*. A print is one of many impressions, or reproductions, of an original drawing. The original may be drawn on stone (a lithograph), on a metal plate (an engraving or etching), or on wood (a woodcut). (*See* Engraving and Etching; Lithography.)

Prehistoric and Ancient Drawings

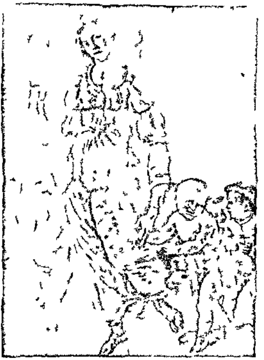
The oldest drawings of which we have any record are those on the walls of caves in which Stone Age men lived (*see* Man). The first of these caves was discovered in 1879 at Altamira, in northern Spain. The most recent was found during World War II at Lascaux in southern France. 'The Stag Frieze', from one of the Lascaux caves, shows early man's ability to draw animal figures with a few lines and to have a complete grasp of the form.

Ancient Egyptian writing developed from drawings which represented objects and events (*see* Egypt, Ancient, subhead "Writing"). Each picture symbol, which included birds, fruit, and flower forms, was drawn in outline with great restraint. It was stylized and stiff and in sharp contrast to the realistic drawings of the cave men.

Greek art is known to us through beautiful vases. The one shown on this page is a cylix, a two-handled drinking cup with a shallow bowl set on a stem and foot. Notice the decorative way in which the human figures are drawn to fill the space. The directness and dignity of the outlines in this vase painting give us some idea of the Greek artist's concern with problems of proportion and figure composition.

Fifteenth-century Italy produced some of the world's greatest artists (*see* Renaissance). One of these was Sandro Botticelli (*bŏt-ĭ-chĕl'ĭ*) of Florence. His

Douris
(about 470 B.C.), Greek.
VOTING OF THE GREEK CHIEFS.
Painted on a cylix.



Botticelli Sandro or Alessandro di
(1444? 1510) Italian
ABUNDANCE
Pen and wash 12¼ in x 10¼ in
British Museum London England

Abundance is a fine pen and wash drawing accented with white It shows Botticelli s use of line to create an emotional effect The central figure seems to advance with a flutter of draperies The movements of the body and the masses of hair are repeated in the curving lines of the horn of plenty The whole drawing is marked by lightness grace and rhythm

Among the greatest artists of the Renaissance were Leonardo da Vinci Raphael and Michelangelo (*see* Michelangelo Raphael Vinci) Michelangelo was both painter and sculptor Many of his drawings are studies of the human body We show here a page from one of his notebooks with sketches for the Libyan Sibyl later painted on the ceiling of the Sistine Chapel in the Vatican in Rome

Artists of Northern Europe

The *medieval* and Renaissance artists of Germany did their best work in engraving woodcutting and drawing Between the mid 15th and mid 16th centuries they surpassed all other artists in these fields It is known that the prints of Martin Schongauer served as inspiration for Raphael and were admired by Michelangelo (For a picture of a Schongauer engraving *see* Feudalism)

The greatest of the German artists was Albrecht Durer (*see* Durer) In the pen and ink drawing The Lamentation (next page) is an example of his intensive use of religious subject matter Many of his engravings and woodcuts are characterized by great detail (For a picture of a Durer engraving *see* Engraving and Etching) In The Lamentation however details are subordinated to the design of the drawing as a whole Vertical lines dominate the composition—in the cross the ladder the upraised arms of the figure on the left The crowded figures form a triangle sloping upward from a wide base to a point at the cross and ladder Skillful use of light and shade gives the figures depth and roundness

Hans Holbein the Younger was the last of the important German Renaissance artists (*see* Holbein) In Flanders Peter Paul Rubens combined Italian influence with the native Flemish style (*see* Rubens)

Holland produced the great Rembrandt van Rijn (*rin*) (*see* Rembrandt) He depicts everyday activities with *simplicity and sincerity* In his drawing of Saskia with Her Child (next page) the sway of the figure is

Michelangelo Buonarroti
(1475 1564) Italian
STUDIES FOR THE LIBYAN SIBYL
Red chalk 11⅜ in x 8⅜ in
Metropolitan Museum of Art, New York N Y

Dürer, Albrecht (1471–1528), German
THE LAMENTATION.
Pen and ink 11⅜ in x 8¼ in
Meta and Paul J. Sachs Collection, Fogg Art Museum, Harvard University, Cambridge, Mass

emphasized in the sweeping folds of the dress and in the way in which the child is clasped in the young mother's arms. Rembrandt's drawings always reveal his concern with problems of light, shade, and space. As in most of his work, the shadows are luminous, and unessential details are omitted.

Artists of the 18th and 19th Centuries

The most famous artist of 18th-century France was Jean Antoine Watteau. His sketchbooks are filled with exquisite drawings of details of human figures, animals, and landscapes. England's greatest 18th-century artist was William Hogarth (*see* Hogarth). In Spain, Francisco Goya became famous for his drawings of the horrors of war and the vices of the Spanish court.

Honoré Daumier, French artist of the 19th century, was deeply influenced by Goya, and like the Spaniard he satirized the evils of his day. Both men were indebted to Rembrandt for their sharp contrasts of light and shade, and to Michelangelo for their handling of form.

Paul Cézanne is regarded as the father of modern painting. He concentrated on the form of things and stressed the idea that natural forms are basically geometric. This analysis was carried further by the Cubists, who attempted to show all sides of an object at the same time (*see* Cézanne).

20th-Century Drawings

The drawings of the 20th century seem to reflect the restlessness, the motion, and the scientific progress of the modern age. Some of them are characterized by free line. Others, like those of Léger, reduce life to geometrical forms (*cubism*).

X-ray techniques, in which one can see the inside and outside of forms at the same time, have produced drawings unlike those of any other period. Artists who are concerned with *expressionism* attempt to record the emotional feeling of a scene rather than its realistic appearance. The *surrealists* are interested in the subconscious mind and in the interpretation of psychoanalytic problems.

A comparison of three drawings of heads illustrates the continuous searching of the 20th-century artist for new ways to communicate ideas. In the 'Head of a Girl with Braids', we have a decorative ink

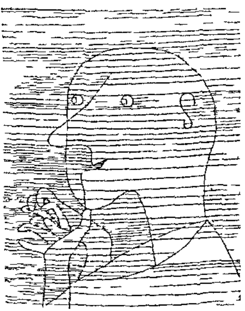
Rembrandt Harmenszoon van Rijn (1606–1669), Dutch.
SASKIA WITH HER CHILD.
Pen and wash 7⅞ in x 5⅛ in
Pierpont Morgan Library, New York, N. Y.

Mat sse Henri (1869–1955) French
HEAD OF A GIRL WITH BRAIDS
Ink drawing 22½ in x 14⅞ in
Art Institute of Chicago
Chicago Ill

drawing by the French artist Henri Matisse (*mà-tes*) His mastery of line is evident in the simple treatment of the hair the sweep of the shoulder and the contour of the face The entire composition is rhythmic Because only essential strokes have been used the drawing is crisp and uncluttered

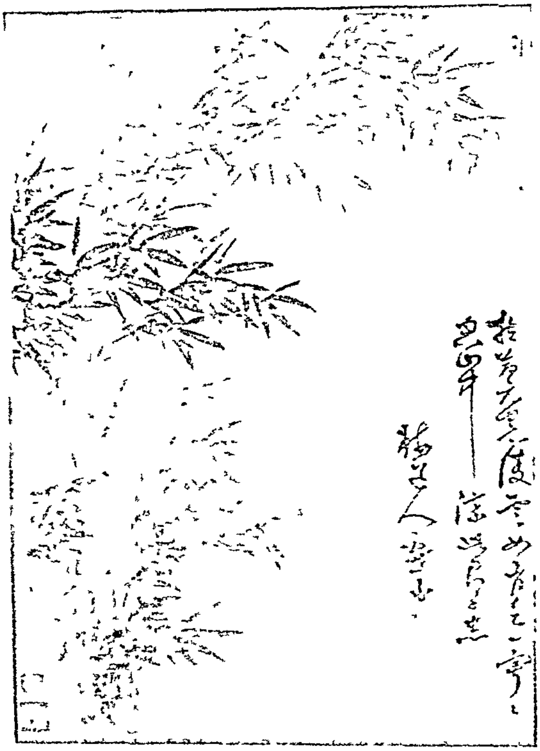
Pablo Picasso a Spanish artist who worked in France for many years experimented with many different techniques One of these involves superimposing transparent planes one on top of the other in order to show several sides of an object at the same time This approach to drawing also makes the subject look like it is rotating slowly In the Head of a Woman Picasso has gone a step further He has eliminated the superimposed planes and has drawn a *double head* in line alone Because of the displacement of the features this head seems to move up down and around The drawing implies psychological as well as physical changes since the expression also continues to vary

Old Man Figuring an etching by Paul Klee (*kla*) looks at first glance like a simple outline drawing overlaid with horizontal lines It is at once whimsical and sophisticated As the old man scratches



Klee Paul (1879–1940) Swiss
OLD MAN FIGURING
Etching 11¾ in x 9⅜ in
Museum of Modern Art, New York N Y

Picasso Pablo (born 1881) Spanish
HEAD OF A WOMAN
Pen and ink on brownish gray paper 10⅜ in x 8¼ in
Museum of Modern Art New York N Y



Wu Chên
(1280–1354), Chinese.
BAMBOO IN THE WIND.
Brush drawing 29⅝ in. x 21⅞ in.
Museum of Fine Arts, Boston, Mass.

his chin with curving fingers, his eyes peer out with a look of wonder from behind irregularly spaced horizontal lines. Klee's approach to drawing is unique and personal. Often it is concerned with mental processes.

The Drawings of China and Japan

Oriental drawings show a masterly use of line. Notice how Wu Chên, a 14th-century Chinese artist, rendered the main stalk and branches in 'Bamboo in the Wind'. The lettering on the right side reminds us of the close relationship in the Oriental between the arts of writing, printing, and drawing.

Japanese prints have become well known to the Western world. Best known of the Japanese artists are Hokusai and Hiroshige, who worked in the 19th century. (For two pictures of Japanese prints in color, *see* Japan.) A Japanese-American, Yasuo Kuniyoshi, produced fine drawings in the United States. One of these is the 'Dream', an ink sketch in which the blend of Oriental and modern feeling is at once apparent. Unlike other present-day artists, Kuniyoshi never used abstract symbols. The animal, the plant forms, and even the figure soaring upward in the 'Dream' can all be easily identified.

Drawing and Commercial Art

Drawing is the backbone of commercial art, a field which continues to gain in importance wherever eye appeal is thought to be significant in selling products. In commercial work drawing is used by the fashion artist, the illustrator, the layout man, and the designer. Compton's Pictured Encyclopedia uses commercial artists to illustrate its articles (*see*, for example in this volume, Digestion).

The comic strips and political drawings in newspapers are called cartoons. "Animated cartoons" are produced by filming hundreds of drawings one after another (*see* Motion Pictures).

A caricature is a political cartoon which exaggerates a situation or a person's characteristics. It has proved a powerful weapon in politics. Among famous caricaturists of modern times were Sir John Tenniel of England and Thomas Nast of America. The latter broke up the powerful Tweed Ring by means of his drawings (*see* Tammany. For other examples of political caricatures, *see* the biographies of the presidents of the United States).

Yasuo Kuniyoshi
(1893–1953), American.
DREAM.
Ink drawing. 13 in. x 19 in.
Collection of Mrs Edith Gregor Halpert,
Downtown Gallery, New York, N. Y.

The Drawings of Children

As soon as a child is able to grasp a pencil or crayon in his hand he makes drawings The early scribbles and the charming drawings of later years made by children and young people were once thought to have little significance Today art teachers encourage every boy and girl to express himself by drawing with freedom naturalness and directness The results are neither imitative nor realistic Each child draws in a different manner The unique way in which he does so reflects his thoughts and feelings in rela t on to the real world of experience and the imagina tive world of the spirit

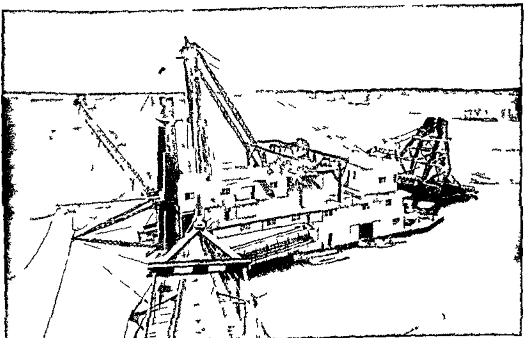
Ch ldren s drawings reveal their physical and mental development Therefore adults must refrain from imposing their ideas on children and they must not criticize the work of children by adult standards Drawing can be an important form of emotional release for the person of any age who attempts to record an intensely personal feeling in his own way (*See also* Arts The Mechanical Drawing Painting)

DRED SCOTT DECISION Dred Scott was an ig norant Negro slave who had belonged to an officer in the United States Army His master had been ordered from Missouri to Rock Island Ill and had taken Dred Scott with him into that free state Then he had been ordered to Fort Snelling in M nnesota Terri tory and again he had taken Dred Scott although Minnesota had been declared free territory by the Missouri Compromise of 1820 (*see* Missouri Compromise) At Fort Snelling Scott had married a Negro woman and when his master was ordered back to Missouri both Dred Scott and his wife accompanied him

After a time the master died and Dred Scott decided to try to gain his freedom He claimed that he was free because he had lived in Illinois and Minnesota where slavery was forbidden The case was finally carried to the Supreme Court of the United States In 1857 a majority of the Court through the opinion of Chief Justice Roger B Taney declared that Dred Scott was st ll a slave and as such had no consti tut onal right to sue in a *federal court* The dec sion further held that Congress had no power to prohibit slavery in the territor es and that the Missouri Com promise was therefore unconstitutional

President Buchanan urged all the people to accept this deci ion as final but the antislavery party of the North refused They declared that the Supreme Court had in the past changed its decis ons on con st tutional quest ons and they cont nued the r ag ta tion aga nst extend ng slavery in the hope of a future decis on as favorable to freedom as this was to slavery (*See* Civil War American)

DREDGES AND POWER SHOVELS Excavating so l from the bottom of lakes rivers and other bodies of water is called dredging It is necessary in



A GREAT GOLD DIGGER AT WORK

This mighty dredge digs gold bearing earth from the bottom of the California River on which t is floating It separates the gold from the mud and sand and then carries the debris out over its two long conveyer arms or stackers to the bank The chain of steel buckets which does the digging can be seen just d pping into the river

BULLDOZERS AND DITCH DIGGERS AT WORK

With their wide blades those three bulldozers above are pushing tons of earth downhill at each sweep to turn that sharp precipice into a gentle slope up which a road can be built. At the right, a ditch digger cuts into the earth relentlessly with its endless chain of sharp-edged claws to scoop out a neat trench for sewer pipes.

deepening, widening, or straightening river channels, in deepening harbors or bays, in building dikes and levees, and in preparing foundations for bridges, lighthouses, and the like. Diamonds and various metals, especially gold, platinum, and tin, are sometimes mined from river bottoms and alluvial soils by dredging. This work is done with powerful machines mounted on floats known as "dredges."

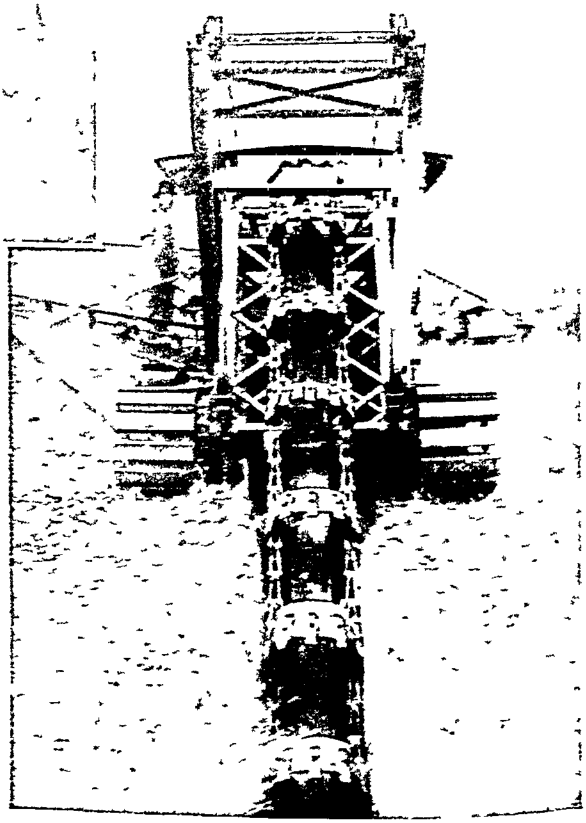
Various Type of Dredges

The most common form is the *dipper dredge*. This is the typical American dredge and is very largely used in river improvement work and in digging drainage canals. It consists of a hoisting engine with a swinging crane to which is attached a great thrusting shovel or dipper. The dipper is lowered to the bottom, and a cable draws it forward into the materials to be raised. Then it is lifted clear of the water and swung around until it is in the desired position for emptying. The bottom of the dipper is hinged, and when a cable attached to the latch is pulled the load falls out.

The dipper dredge can excavate all kinds of soil and can even rip through soft rock without blasting. The usual capacity of the buckets is from one-half a cubic yard to six cubic yards, although in the construction of the Panama Canal two mighty machines were used with a capacity of 15 cubic yards or about 15 tons to each bucketful.

In the *clamshell grapple dredge*, a bucket composed of two great scoops, hinged at the top, is dropped from the end of a beam; the two halves are then closed, and the whole is raised by chains and tackle. Another grapple dredge has an "orange-peel" bucket composed of three or four triangular blades which reach down like a giant hand and close over the materials to be raised. The grapple dredges are operated in deep water where dipper dredges could not reach to the bottom.

Dipper and grapple dredges are often known as "intermittent" dredges. The "continuous" dredges are of four types—ladder, hydraulic, stirring, and pneumatic. The *ladder dredge* ex-



cavates by means of sharp-edged buckets, speeding along an endless chain or wheel.

The *hydraulic dredge* draws soil into a suction pipe and forces it through pipe lines using a centrifugal pump A revolving cutter loosens the soil and mixes it with water so that it will be readily sucked up This type is used to fill in waste lands along waterways and to maintain navigable channels The water and soil sucked up from the river bed are pumped out through long pipe lines and discharged over the area to be filled The water drains away and the soil is left Such dredges may put out to sea and discharge the soil and water into barges from which it is pumped upon the land to be filled This was done at Galveston after the flood in 1900

The *stirring dredge* opens channels for navigation, at the mouth of the Mississippi, for example, by agitating mud and sand until the current carries them away With this type of dredge the Venetians have removed sand bars since the middle of the 14th century

Pneumatic dredges use compressed air to drive soil and water through a discharge pipe They are employed when it is necessary to force materials to a great distance or up to a higher level

The Giants That Dig on Dry Land

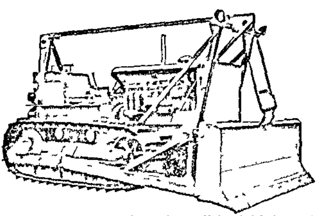
Power shovels are the dry land excavators They dig like the dredge with a dipper or a clamshell bucket Power shovels driven by gasoline, Diesel, or electric motors have almost entirely replaced their puffing ancestors the *steam shovels*

They may be mounted on stationary bases, as is the case with those used to unload ore and coal from freight vessels or they may be equipped with wheels to run on rails or mounted on giant tractors with caterpillar treads Those that work from a fixed position may be mounted on turntables which let them sweep around a complete circle Motor and control cabin may also ride around on the turntable so that the operator always faces the work

Power shovels are universal tools They serve in dam and highway construction, in leveling rough ground, and in excavating for buildings, sewers, and canals They dig iron ore in the Lake Superior region, copper in Montana, and coal in the strip mines of Illinois

An adaptation of the power shovel is the *bulldozer*, shown above Its specialty is clearing land and pushing soil and rocks rapidly from place to place

CLOSE-UP OF A MIGHTY EARTHMOVER



The bulldozer proper consists of that wide heavy blade and of the framework which attaches it to the tractor The blade (dozer) is lowered and lifted by means of the wire cables that lead through the overhead framework to the back of the tractor Note the cable control handle behind the driver's seat

DRESDEN, GERMANY The cupolas and spires of Dresden stood for generations on the upper course of the Elbe River about 110 miles south of Berlin and about 40 miles north of the mountains that divided Saxony from Bohemia It was a treasure house of art and culture for all northern Europe But its industries made it a military target, and in the second World War Allied planes bombed it into ruins

Dresden was founded by the Slavs It is known to have been an established community in 1206 As capital of the Duchy of Saxony and later the Kingdom of Saxony, it was at various times joined by its ruling house to Bohemia, Poland, and Brandenburg

Lying respectively on the east and west sides of the Elbe the Altstadt and Neustadt (Old and New Towns) were joined by five bridges Buildings of monumental architecture occupied the heart of the city Included among them were the Royal Palace, Theaterplatz, Administration Buildings, and many churches Rococo ornamentation was a feature of Dresden's later architecture

Within the famed Zwinger Museum hung paintings of the Dutch, the Flemish, and the Italian schools In one of the most important collections of Renaissance masterpieces a place of honor was occupied by Raphael's Sistine Madonna Music too held a high place in the arts The famous Hoftheater was, at times, directed by such masters as Wagner and von Weber Wooded parks and cafés in the terraced gardens overlooked the Elbe A summer theater added to the entertainment of the people

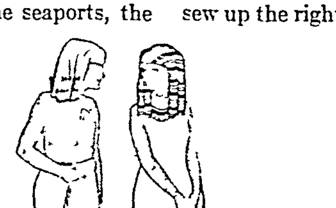
Dresden was the hub of an extensive railway system reaching all the important points in Germany and Austria. A thriving river traffic supplemented the railroad lines Dresden was especially noted for its crafts, such as gold and silver work, lacemaking, bookbinding and publishing Pianos and musical instruments were manufactured as was agricultural machinery The famous Dresden china was made at Meissen, 13 miles down the Elbe

Near the city Napoleon won his last great victory, the battle of Dresden, in 1813 In the second World War much of the architectural fabric of Dresden was destroyed by Allied bombs and by Russian artillery when Soviet troops took the city in May 1945 (*See also* Saxony) Population before the war, about 640 000 (1946 census), 467,966

The PAGEANT *of* DRESS *through Fifty Centuries*

The Curious and Interesting History of Styles, from the Early Egyptian Loin-Cloth to the Modes of Today

DRESS. With the spread of modern civilization, special national costumes are everywhere fast disappearing. Ready-made clothing puts man and master, maid and mistress, in the same style if not in the same fabrics. Humdrum overalls are replacing the picturesque cantonal dress of Switzerland, and the quaint Dutch national dress is rarely seen except in places where it is worn to attract tourists. Even in China and Japan, especially in the seaports, the more convenient and prosaic dress of the western countries is being adopted. The kilt of the Highland Scots has practically disappeared except as the national court dress and the uniform of the Highland regiments of the British army. The old national dress of southern Albania is similarly preserved in the uniforms of the Greek army; it, too, is a kilted affair, with flowing white sleeves, a sleeveless embroidered jacket, and a broad sash.



Thanks to the torrid climate, "cool and simple" was the rule in old Egypt.

Greek and Roman Costume

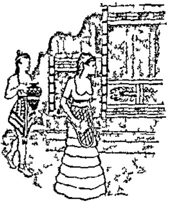
The development of costume was influenced largely by the desire to make the dress tell something of the position or rank of the wearer. In early Egypt and Babylonia, kings, priests, and other officers were distinguished by the vestments they wore over the ordinary apron or loin-cloth, which later developed into a long skirt. The draped costume reached its highest development in the dress of Greece and Rome. The garments were chiefly pieces of cloth hung in elaborate folds and fastened with girdles and brooches. The principal garment of Greece was a long sleeveless tunic of light texture (called "chiton") worn next to the skin. Over this was draped the "peplos"—a square piece of woolen cloth about a foot longer than the height of the wearer. The upper quarter was folded down, and the whole garment was then doubled and wrapped about the body, and fastened over the shoulders with brooches (called in Latin *fibulae*) of the type of our modern safety pins. This remained the dress of women, especially in the Doric states. The peplos was usually worn girdled about the waist, and in Athens it was customary to sew up the right side from below the arm. Men wore also the "himation," a square of woolen stuff similar to the peplos but draped across the chest and over one arm; and women wore the himation in different colors as an overgarment. A lighter garment was the "chlamys," a short mantle worn by young men.

The "toga" was the national dress of Roman citizens, and was always worn outdoors, except by workers. It was a great circular piece of woolen material and corresponded, but for the difference in cut, to the Greek himation. The women wore a long tunic ("stola") with a border of darker color along the lower edge. Over this was draped a garment called a "palla," arranged in many graceful ways, according to the whim of the wearer. The toga worn by lads under 16 years of age—and also by certain officials—had a border of purple and was known as the *toga praetexta*. For special occasions, such as a general celebrating a triumph, a purple toga with embroidery was worn over a gold embroidered tunic and this became the "purple" of the emperor.

Origin of the Dress of Today

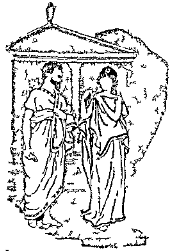
Men's clothing of today can be traced pretty plainly back to the 17th century. The long trailing garments

of the Middle Ages with sleeves so long that they had to be knotted up to keep them from dragging in the mud had passed and so had the puffs and slashes and trunk hose and the grotesque parti-colored clothing of Elizabethan days which viewed *from one side* seemed to be a costume of red and white perhaps and from the *other side green and yellow*. The doublet the ancestor of the coat had gradually become longer and had buttons and but*tonholes reaching* its entire length and the long loose sleeveless waistcoat showed beneath. The great petticoat breeches of the early 17th century became smaller and were fastened below the knee. Instead of the ruffs and lace collars of the earlier day broad but plain linen *collars were now worn*.



In ancient Crete the women's costumes were strikingly like some 19th century European modes

For convenience in riding horseback the ordinary method of conveyance then the skirts of the long coat were turned back and buttoned in the small of the back and men's frock coats still retain these (now use*less) buttons*. The tops of these early coats were cut so they could be fastened up *around* the neck and *the V shaped* nick which is in all modern coats is a survival of this custom. Gradually the coats were shortened and cut away *in front*. The modern evening dress represents a further such cutting away of material. When the swallow tail coat was first worn the tails reached the ground.



Lovers of beauty in all things the ancient *Greeks achieved perhaps* the most graceful costumes known

Like the Greeks, the Romans wore graceful flowing garments usually of white. The men's outer garment was known as the toga, the women's was called the palla.

Wigs of various kinds have been in use since very early times. Queen Elizabeth *had more than 80* wigs of different colored hair and more than 3 000 gowns of strange fashion. As an indispensable article of gentlemen's *dress the wig began in the middle of the 17th century with Charles II*. The heyday of the wig came in the 18th century. The shapes it assumed were innumerable. There were wigs for clergymen and for doctors the *man of law wore a huge tie peruke* and the army and navy a great *cluster of temple* curls with a pigtail behind. The fashion of powdering the hair came in from France and continued through a considerable period. The wig is still worn in *the* English law courts and by the speaker of *the House of Commons*. Washington as we know him from his pictures wore a powdered wig.

Frankish modes in the time of Charlemagne

In the early 15th century men in *western Europe fancied puffed* sleeves and pointed shoes

About this time—1770—the high headdresses for women came in and found their extreme examples in

SOME QUEER COSTUMES IN TIME'S FASHION PARADE

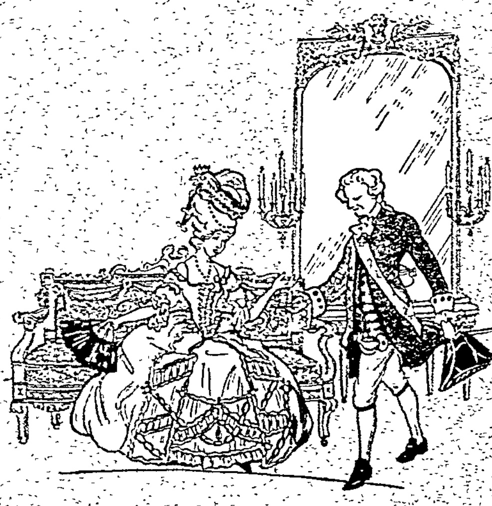
Burgundy—Late 15th Century

German—Late 16th Century (Showing Spanish Influence)

French—Early 17th Century

Dame and "Elegant" of 1695

French Sweethearts of 1760



Courtiers—Marie Antoinette Period

London fashionables in the dawn of the 19th century. The two on the right have the latest style from Paris and feel correspondingly superior

France. The bodies of these enormous structures were formed of tow, over which the hair, perfumed and kneaded with pomade, was drawn in curls and rolls. The whole was freely plastered with powder, and decorated with great bows, ribbons, feathers, and flowers. Sometimes these enormous structures were surmounted by a representation of a ship in full sail, or a miniature garden, and some were so high that it was not possible to enter an ordinary door without stooping.

When fashionable Americans went walking at the time of the Civil War the women wore hoop skirts and carried parasols. The men wore tight trousers, flaring coats and high silk hats

During the French Revolution the three-cornered hat, the powdered wig, the pigtail, and knee breeches all began to go out of style and simpler fashions gradually became settled. Long trousers were first worn by the "breechesless" (*sans culotte*) rabble of the Revolution, but they soon became a part of the conventional men's dress of today. Knee breeches, however, are still worn in English court-dress and for sports wear.

Long tight trousers were the style of the early 19th century, and the dandy wore doe-skin trousers and a coat of blue, claret, buff, or brown, thrown back to reveal the waistcoat. Until near the close of the 19th century it was not fashionable to have the trousers creased, for this was the mark of store (ready made) clothes that had lain folded on a shelf—the "hand me-downs." With the rise of the high hat (beaver, later silk) in the 1830's, the last phase of men's fashionable costume was entered. Later styles have been modifications of the ideas launched during this period.

The great starched ruff and the farthingale are the outstanding characteristics of women's costume in the days of Queen Elizabeth. These ruffs, stiffened with wires and spread over concealed frames, became so enormous that it looked as if the head were being carried on a huge platter. The skirts became extended until they stood out at right angles to the body. This was the first appearance of that curious *thing, the "hoop skirt" or "farthingale," as it was* called at that time. Its next appearance was in the 18th century, when a tight-fitted bodice, often sleeveless, surmounted great billowing petticoats, and over these hoop skirts the gown was draped and looped like a drawn curtain. In 1750 the hoop petticoat had attained such proportions that ladies found it difficult to pass each other in the narrow streets of London and Paris. The last wave of the extended skirt or "crinoline" came in the 19th century. It was at its height in the United States in Civil War times, and echoes of it continued in the bustle and hip-pads even into the present century.

Near the equator, both men and women wear some modification of the skirt, while in the more strenuous life of the Arctics, both men and women wear trousers. In the great temperate zones, the men have kept the trousers and the women the skirts for the most part. The freedom of action which slacks or overalls give has led many women to wear them for certain sports and for hard work in factories or on farms. (*See also* Hats and Caps, Shoes.)

Styles of the 1890's featured leg of mutton sleeves and an hourglass silhouette. Skirts were lined and had a stiff interlining to make them stand out at the bottom

Dressing to Suit Personality

EVERY girl or woman can be attractive in appearance if she plans her clothing according to proper principles. For clothing can be made to conceal one's defects and to emphasize one's best features.

Broad principles, rather than hard and fast rules, govern style and appropriateness in clothing. Good designers ignore many rules. Good taste demands clothing that is not peculiar and conspicuous. The well dressed person, therefore, conforms to fashion, while keeping in mind her own individual needs and characteristics.

The Question of Lines

Three basic laws of drawing and painting are generally adaptable to dress design:

1. Lines following the body contours emphasize and draw attention to the curves. If these are unlovely, this law is obviously a warning.
2. Lines opposing the body contours also emphasize the curves by making each one seem like part of a circle.
3. Lines cutting the contours lead the eye away from prominent curves and focus the interest elsewhere.

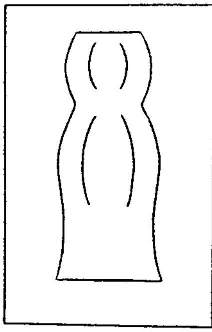


Fig. 1

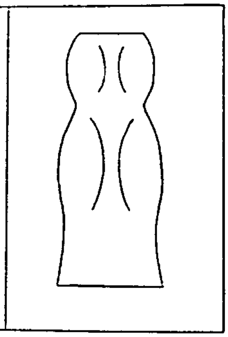


Fig. 2

The four diagrams on this page, all drawn with the same body lines, illustrate these laws. In Figs. 1 and 2, the dress is designed and fitted to demonstrate Laws 1 and 2. Notice that in both these diagrams the curves are emphasized. Figure 2 shows that the curves of hips and bust seem more prominent when each line partially completes a circle.

Lines that cut the body contours may be straight or curved. Those used in Fig. 3 are straight and severe. They carry the eye sharply past the large hip curve to an accent at the waist. The lines crossing the bust are also sharp and draw attention to a point below the curve. In this figure the waistline can afford to be the center of interest, because it is small in comparison with the bust and hips. By drawing attention to it, we produce the illusion of smaller hips and bust. In Fig. 4, the lines that cut the contour are curved. They appear more graceful than straight lines, but they produce the same effect. The curved lines at the neck of a dress may be created by seams, by folds of material, or by a necklace.

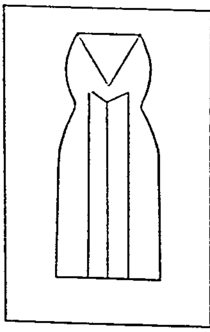


Fig. 3

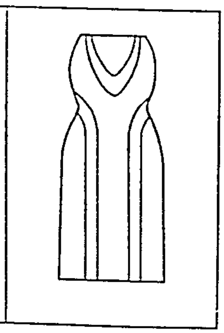


Fig. 4

Notice that in Figs. 3 and 4 the skirt falls straight from the largest part of the hips. In Figs. 1 and 2 the skirt is fitted in below the hips, making them more prominent.

Besides the three laws already given, the only infallible principles of dress design are that horizontal lines carry the eye from side to side and broaden any space, and that vertical lines carry attention up and down, lending height. We can best understand the problems involved by studying each one separately.

We may divide women into two groups, thin and fat. Thin women, tall or short, may be considered as a single group; and for them certain details of design should always emphasize the horizontal lines. The hips will be loosely fitted; and gatherings, extra panels, or pleats, as dictated by fashion, will soften the angular outline. The thin chest should never be exposed, and fashion generally takes care of this. Thin necks are helped by soft rolled collars, folds, laces, and gently rounded necklines. Lack of bust may be offset by jabots, vertical or horizontal tucks or pleats, or large bows. Thin women should never wear high, puffed sleeves, because the arm exposed below them seems longer and thinner, by contrast. If the sleeves are short, they should be plain, but long full sleeves are best.

The heavy woman, whether tall or short, presents a greater problem. Adding cloth solves problems for thin women, but to add cloth in an attempt to make a large figure appear smaller is admittedly more difficult. With Law 3 in mind, large hips may be cut by seam lines in almost any way except horizontally. Lines which carry the eye up and away from the hips are best. One narrow panel up the center front is, however, not sufficient, because it leaves a round curve on each side. In like manner, Law 3 governs the problems of the large bust; interest must be led away from the curves. Never put tight sleeves on plump, bulging arms. Use, rather, loosely fitted sleeves which draw no attention to themselves, with a definite withdrawal of the interest to another point.

Like any other too prominent curve, the *lordosis* curve (swayback) presents a problem for the dress designer. Various ways of solving the problem are: bloused backs; short jackets; dresses plain in front, with no added interest or trimming; and the use of shirring or fullness at the waistline in back.

Tightly fitted cloth always makes defects more prominent. Softly fitted material, on the other hand, can create illusions. For example, a roll collar is just as effective in disguising the too plump neck as it is

a flattering the too thin neck When fashion demands closely fitted bodices or skirts or sleeves, individual necessities must alter the mode

Differences in age must also be considered in providing becoming clothing *for fat and thin figures* Figure 5 illustrates how simply the fat little girl should be dressed She must have vertical lines not horizontal, widening ones, and no added fullness or ruffles Figure 6 illustrates the principles for the thin child Horizontal lines *are exactly* what she needs and soft fluffy hair, shirred fullness at the yoke, puff sleeves and dainty ruffled or pleated edges fill in the scant outline

Fig 5

Fig 6

A girl a few years older presents additional problems The ideal characteristics of youth are a high small bust, slim waist and hips, soft curves of face and throat If a girl has these advantages plus good taste in color and a knowledge of what to wear on various occasions, she need have no worries *over clothes*

Most young girls, however do have worries and they are caused by problems in the two basic classifications we have considered The tall gangling girl has prominent bones and is usually awkward Dainty *trimmings or delicate shirrings* will *exaggerate* her angularity She therefore needs fullness through the bust, sleeves and skirt or a *large collar cuffs* and belt. Large details of design will fill in the hollows, hide the boniness, and lessen her appearance of awkwardness Figure 7 shows the tall young girl who has grown too rapidly and has become self conscious The slim, form-fitting dress *in no* way conceals her defects Figure 8 shows the same girl flattered by her hairdress and clothes, which *fill in the* silhouette at the points most conspicuously thin.

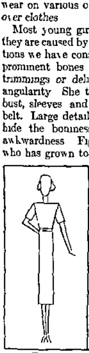


Fig 7

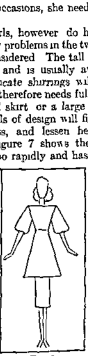


Fig 8

The plump young girl, *whether short* or tall needs simplicity first, and vertical lines second Sharp angles and straight lines will solve her difficulties Figure 9 shows the over plump girl with hair fluffed about the face and with full sleeves and strong *horizontal lines at* waist and hip Her head and each horizontal section of her dress is a broad expanse Figure 10 shows *the same body*, but with the girl s hair neatly arranged to lessen the apparent width of her face, and with her dress designed to produce simple vertical lines

For the young matron or the woman of *forty or* more the main consideration is to "dress her age" *There is little excuse for the young matron* who chooses designs with old ' lines On the other hand a middle-aged woman usually looks older in youthful clothes She should choose from the smart designs specially *made for women or her age* Whether she has dignity, sophistication, *or motherly* sweetness the graciousness which her age connotes should be apparent in her clothes Ease ' is the keynote, and it is gained by the use of draped lines, *folds* and long *subtle curves*

Fabrics and Color

To achieve personality in clothes, we must consider other matters besides the lines of garments The most important are the colors and fabrics used For example, fur, soft fabrics and soft shades of color give an impression *of greater luxury and delicacy than do worsteds and* hard colors

Color in relation to line is a good starting place for study Bright colors and large patterns of color in dress materials make the wearer seem larger Dull colors and dark shades have a slenderizing effect Red white and orange are aggressive, they come to *meet the eye more than the receding colors such as* black dark blue, and dark green A touch of an aggressive color however *can often be used effectively* as a contrast to liven up a dull-colored dress

It is generally recognized that colors also tend to suggest personal qualities Red *is a warm color,* gay if bright red and friendly if dark It seems naturally suited to a gay or friendly person, and to winter weather Blue is cool *It is there*fore a good summer color, or is suited especially to a cool well-poised person.

Fig 9

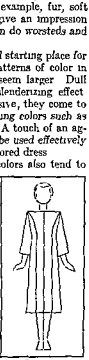


Fig 10

Light blue gives an impression of delicacy But the *darker blues, especially* those which border on the blue-violet suggest intensity and power, most women should use them *sparingly Yellow is a sunny, light*-hearted young color, less sophisticated than the others Purple is a "royal" hue, best on stately types Green which is a mixture of yellow and blue, is cool and youthful Orange a mixture of red and yellow, is the

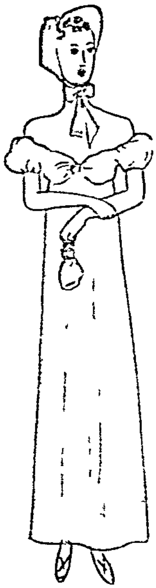


Fig. 11

warmest and brightest of all colors, unsuitable for most women to wear, except in small touches or else in fabrics which themselves draw attention away from the color, such as rich velvets or dull-finished laces.

Colors in Combination

Since colors do have such definite characteristics, one must be careful in making combinations of them. Some colors harmonize, and others do not. Inharmonious colors produce an effect comparable to a discord in music; and some of these discords, for example, the effect of blue-violet next to a certain shade of red, literally blur the beholder's vision. A combination of colors so unhappy as this drowns out the personality of the wearer. When the value of a color is altered, either by adding white to produce lighter *tints* or adding black to produce darker *shades*, the contrast of the altered color with other colors is weakened. Thus, there is much less danger of violent discords, when tints or shades are used in a design.

Each of the primary colors—red, blue, yellow—has its "complementary" color, which is a mixture of the other two (*see* Color). If we place side by side two bits of cloth in complementary colors, we find that each makes the other appear more vivid. Thus red and green intensify each other; so do blue and orange; so do yellow and purple. A neutral hue placed next to a color tends to take on a tinge of that color's complement. For example, a light gray next to red looks greenish.

Complementary colors combine most pleasingly when they are of the same value and purity—that is, with equal amounts of gray or white added to dull them. In dress goods, we seldom find colors at their fullest purity, and the amount of gray in each naturally affects the way two pieces of cloth will look together.

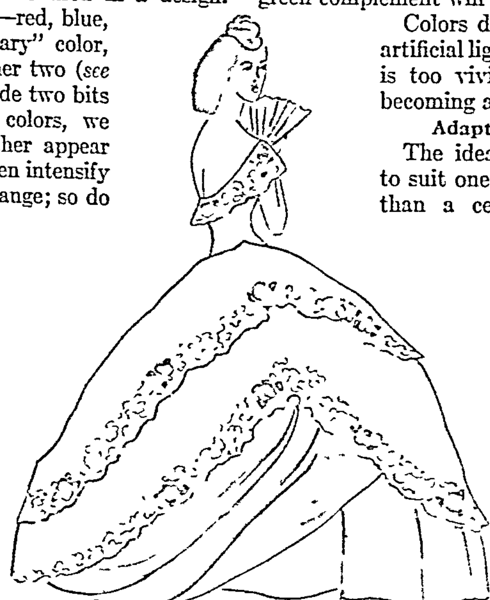


Fig. 12

Whether or not a color is becoming depends upon the color of the skin, hair, and eyes. A color that matches these features or that is complementary to them is suitable. Thus no color is likely to be equally becoming to a blonde, a redhaired girl, and a brunette. But so much depends on subtle differences of tint or shade that there can be no fixed rules.

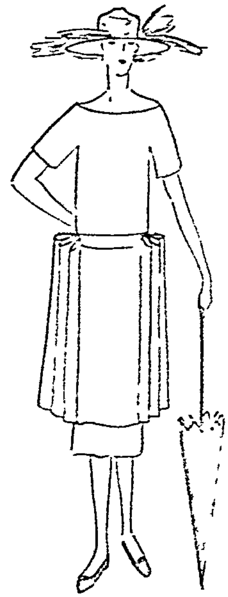


Fig. 13

Each person must try colors with one another and against the face to choose those which are best suited to her. Here are a few suggestions: Plain, dull black drains the face of color; whereas white throws color and vitality into the skin. An intense yellow gives the skin a tinge of violet which emphasizes its deficiencies, particularly if the skin is sallow. Bright yellow should therefore be worn only by a woman with a perfect complexion. To bring out the color of the eyes, one can use a large duller area of the same hue. The girl of florid complexion must be wary of pure blue near the face for the orange complement of blue exaggerates the color of her skin. If she wears red-violet, the yellow-green complement will be flattering.

Colors differ in different lights. Most artificial lights are softening; a color which is too vivid by daylight may be very becoming at night.

Adapting Styles to Personality

The idea of modifying current styles to suit one's personality is scarcely more than a century old. In earlier days women of all ages and shapes wore the same styles. Changes in fashion were brought about to suit the individuality of queens and high ladies of the court. Everyone else followed whatever fashion the royal idiosyncrasies dictated. New modes were generally named after the historic period or after the originator, and much of their effectiveness lay in their contrast with the styles which preceded them.

An example of a style worn by all, though obviously suited only to women with perfect shoulders and well-proportioned hips, is that of the Empire period, 1804–15 (Fig. 11). Its exquisite simplicity was in startling contrast with former extravagance of fabrics and jewels, as well as with the style which followed it—the Eugénie crinoline (Fig. 12). The billowing Eugénie hoopskirt is said

to have been adapted from the farthingale style of Elizabethan days to conceal the figure of the Empress Eugénie when she was expecting a child Thus the whim of an Empress completely changed the style for thousands of women and girls

As recently as the early 1920s current fashions were often rigidly followed whether or not they were becoming (Fig 13) The dress hung from the shoulders like a sack and was often further disfigured by added width at the hips A style of this kind is not only unattractive but by its very design is rigid and incapable of adaptation to different figures

Styles have become increasingly flexible in recent years and any woman can find clothes easily adapted to her own needs among the widely diversified styles of today

Fig 14

Fig 15

Fig 16

Fig 17

(These and other sketches with this article were prepared by the Department of Dress Design of the Art Institute of Chicago)

Choosing Hat Designs

Lines color and fabric are as important in hats as in dresses If the lines of a hat are to do their best for the wearer's face and conceal its defects in shape they must be chosen according to the three laws given for dress lines

The too round face becomes less full if the hat has sharp cutting lines The hat of 1899 (Fig 14) is an excellent example with all lines leading the eye up and out from the face *If you cover the* hat you will notice how much fuller the features seem The quaint bonnet of 1850 shown *in Fig 15* is excellent for the long thin face The dainty ruffle near the face fills in the hollows the ribbon loops on either side and the bow at the chin give width *and all the* lines are therefore broadening Figure 16 shows a perfect oval face surmounted by an Empress Eugénie hat that would not be becoming to round *long or* heavy faces The true oval face wears any hat well because there are no defects to *overcome* The square face is usually strong and needs a boldly designed hat such as that shown in Fig 17 *A hat* of this kind (style of 1905) softens the too strong face and makes it seem smaller

Styles in hats change rapidly The hat styles of our mothers which we laugh at today may tomorrow again be in the height of fashion But hats like dresses now have individuality and every modern hat style leaves room for personal adaptation To choose a becoming hat a woman should stand before a full length mirror and see the hat in relation to the lines of the figure and the lines and color of the costume as well as in relation to her face She should note the effect from both sides and from the back

An excellent way to judge the costume as a whole is to stand in front of a strong light so that only the shadow or silhouette of the figure is shown in the full length mirror Silhouettes should have a general harmony of mass and line and one strong point of interest Next one should stand facing the light and the mirror to be sure that there are not too many different fabrics in the ensemble and no conflicting types of ornament

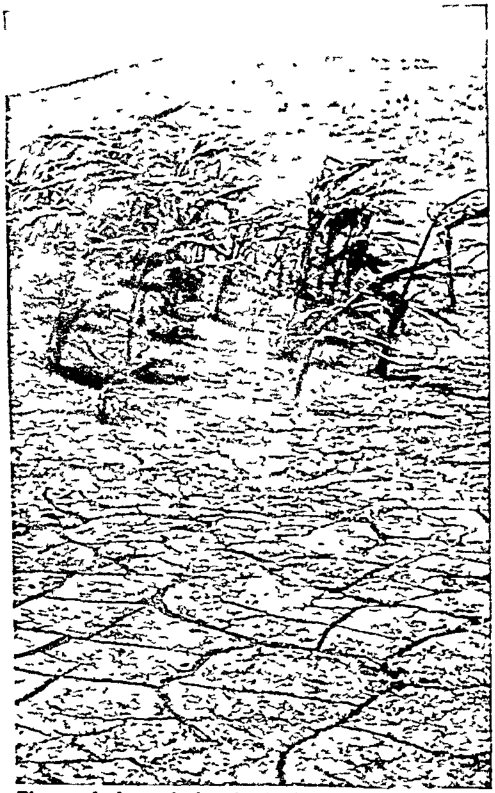
Jewelry should be chosen with even greater care than its background if that is possible for the jewelry may become an exquisite addition to a costume or may ruin the entire effect It should be suited to and not compete with the dress Since jewels semi precious stones and plain metals are worn for their brilliance luxury and individuality they should become the center of interest For that reason strikingly different pieces are often the inspiration for the dress which they set off and expensive jewelry is usually given the background *of a beautifully simple gown*

Accessories are the final test of good taste and grooming They may become the most interesting part of the costume or may lack special interest as style dictates but to the observing person they determine the success of the ensemble A new dress may fail completely in its effect if judgment has been used too sparingly in selecting the accessories or if shoes stockings bag or gloves are not suitable for the occasion

When DROUGHT *Scourges the* FARM LANDS

DROUGHT. Farmers count upon a certain average amount of moisture year after year. They choose their crops to fit the rainfall of their region; for example, cotton or corn for a fairly moist area, hard wheat for a drier climate. They graze cattle on land too dry for wheat They plow and sow at different times and in different ways to meet the probable amount and time of the greatest rainfall

Every year brings farmers anxious days, unknown to most city dwellers, when they search the sky for rain clouds or for a let-up of rain. Excessive moisture brings rust, blight, and mildew to the crops or delays plowing. But the farmer most fears drought, which may shrivel his crops and kill his live stock by starvation.


The parched, cracked soil tells its own story of what drought does to the land, just as the dying corn tells of the ruin it brings to men whose living is in crops.

Plants, animals, and men are distributed over the face of the earth in ways determined by the usual rainfall, and their welfare depends not only on a sufficient amount of rainfall, but on rain at the right season. Corn thrives best with abundant rains in July; cotton needs showers in May. Drought may plague a region even when the total rainfall for the year is large.

The variations of rainfall from place to place and from year to year used to be regarded as a hopeless puzzle. Yet scientists now believe that the variations may follow a pattern. They hope to discover this pattern so that they will be able to forecast droughts. Weather bureau records have not been kept long enough to be of help. They serve, however, to check the accuracy of natural weather records which scientists use for more ancient information.

Clues to Droughts in the Past

The most exact natural record of weather is found in tree rings. Usually a tree adds a separate layer of wood to its trunk each year. These rings are thick in years of plentiful moisture and thin in dry years. When a tree is cut down, the sequence of wet and dry years can be read backward from the outermost ring. Some years, however, there may be more than one ring, partial rings, or missing rings due to fire, drought, frost, or disease (*see* Trees). False rings may be detected because they have fuzzy rather than clear-cut outer edges This tree-ring record won widespread notice when it was applied to the giant sequoias of California by Ellsworth Huntington, Ernst Antevs, and A. E. Douglass. Sequoias sometimes live to be about 4,000 years old (*see* Sequoia); hence they afford a tree-ring record that reaches back to early historic times For shorter spans, scientists use other trees, many of which react to weather conditions more reliably than the sequoia. Professor Douglass has carried records back in the southwest to A.D. 11 by studying tree rings of wood preserved in ancient pueblos.

Changes in the shore lines and levels of lakes also help in these studies. Goose Lake, on the boundary between California and Oregon, provides an interesting example of such changes in recent times. Pioneers, on their way to find gold in California in 1849, wore great ruts along the edge of this lake. Then for half a century wetter weather caused the lake to rise and cover the tracks until they were almost forgotten. During the droughts of the 1930's, however, the lake level fell again, exposing these old tracks.

Owens Lake in California is salty because it has no outlet, and receives salt brought in by rivers year after year. But scientists compute that it has gained all the salt it contains in not more than 2,000 years Hence 2,000 years ago the lake must have had an outlet. The only outlet to be seen in the surrounding mountains is 100 feet above the present lake level, so rainfall must have been great enough in that region 2,000 years ago to maintain the lake at that level

In early times a wall was built near the Caspian Sea to keep out nomad invaders from Asia. History records many occasions since then when the wall was submerged by the sea, and others when it stood far above the sea. This too is evidence of changing rainfall.

The bottoms of many lakes have been filled with silt, a new layer being added each year after the period of high water. In wet years, these layers, called *varves*, are thicker than when formed in dry years Thus, like tree rings, varves record rainfall.

Palmyra, in the present Syrian Desert, has scarcely 1,500 inhabitants; but in ancient times it was a gar-

den city which is estimated to have had a population of 150 000 Only a great change in rainfall could have caused such a loss of population In Yucatan and Guatemala on the other hand we find the ruins of a Mayan civili zation in a region now so damp that it is almost uninhabitable

Lake dwellers once built their homes on stilts rising out of the Swiss Lakes (For pictures *see* article on Man) When the water rose or fell, new houses had to be built Whole series of such houses have been found by archeologists some high built in wet times and others low, built in dry times

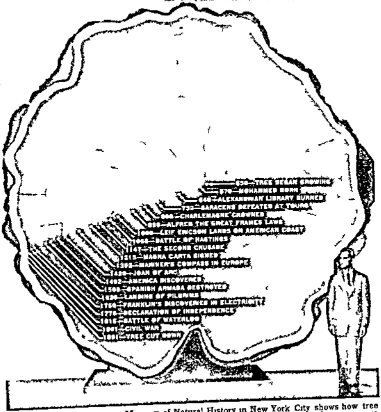
Drought Periods and Migrations

All this evidence taken together, convinces scientists that wet years come in groups followed by groups of dry years These changes are called *cycles* and if only they came regularly we could forecast wet and dry years accurately So far no regularity in these cycles has been established The only rule observed is that droughts usually extend over a number of years growing gradually worse in the first years and then subsiding gradually Scientists might be able to forecast wet and dry years if they knew what causes such changes This problem is being studied intensively but only the beginnings of success have been won (*see* Climate)

On many occasions throughout historic times great hordes of nomadic peoples have come out of Asia to attack and destroy farming communities settled in moister lands We feel reasonably sure that such movements must have been the result of droughts in Asia, which forced the herdsmen to move (*see* Migration of People) The population of thickly settled countries such as India and China cannot migrate when drought strikes Under such circumstances millions of people may starve to death

Drought afflicts some part of the United States almost every year But the country is so large that drought in one region has been balanced by good crops elsewhere, and a true famine never has followed

THIS TREE TELLS OF 1 341 WET AND DRY YEARS



This exhibit in the American Museum of Natural History in New York City shows how tree rings keep a record of climatic conditions through centuries It is a section cut from a sequoia named Mark Twain, felled in 1891 It shows a growth ring for every year of the tree's life. Their varying thicknesses indicate drought or good rainfall in California for centuries

The American Drought Belt

Most of the United States either has adequate moisture or is so dry that agriculture without irrigation is impossible Between the Rocky Mountains and the Missouri River however lies a belt of land which sometimes receives moisture enough for farming and sometimes receives scarcely any rain at all The land is level or rolling with no trees or boulders to hinder plowing In favorable years short grass flourishes and during many past centuries this grass has made the soil fertile with humus from its decaying roots Early settlers were tempted by these prairies and took up homestead farms there

Then in the 80 s and 90 s great droughts came lasting many years Corn wheat cotton and grass alike withered Cattle died farmers moved elsewhere

But wet years came again Crop prices rose as city population grew New settlers took up the abandoned farms and pushed ever farther into the danger zone of insufficient rainfall This time they were better equipped with methods of *dry farming* They had varieties of corn wheat and cotton able to withstand drought to some extent Machinery dug deeper wells new types of harrows pulverized the soil after each rain so that the moisture would sink in instead of

evaporating. Even during the droughts which occurred during the first World War, high prices gave dry farmers a good living.

Beginning about 1930, however, a new dry period set in, this time accompanied by low depression prices. In 1934 the whole Great Plains area, together with many other parts of the United States, faced complete crop failure. Crop damage totaled as much as 5 billion dollars. In 1936, drought struck again, with even more disastrous results. In one state, three-fourths of the population needed government relief.

Everyone Suffers When Drought Comes

The great droughts of 1932 and 1934 found the United States with a large surplus of food stocks raised in earlier years. These carry-overs saved the country from food shortage. But for years the carry-overs had been depressing farm prices, thereby impoverishing farmers and lessening their ability to withstand drought losses. When the drought of 1936 came, the carry-overs had been reduced to normal and food prices rose sharply; but the rise did not benefit drought-stricken farmers who had nothing to sell.

Higher food prices worked injury upon city dwellers. They were hurt also because impoverished farmers could not buy city-manufactured goods. Thus everybody loses when drought strikes.

How Drought Hurts the Land

The greatest injury is done to the land itself. Lands subject to drought usually have a natural cover of grass alone. Trees do not thrive there. The grassy carpet acts as a natural protection against some of the evil effects of drought. Even though the grass may be dying from drought, the roots hold together for some time and protect the topsoil from being washed away by rain or blown away by wind. When the moisture comes again, the roots usually revive, or dormant seeds sprout, and the grassy blanket is soon restored.

But when the plow has removed the natural blanket of grass from the prairie, drought may strike a deadly blow. Dry-farming methods reduce the topsoil to a powdery fineness. When dry, it is easily blown away by the wind. At first sheets of it are peeled off; then, along lines where the winds are strongest, gully-like *blowouts* may develop. If this wind erosion continues, it strips the land down to barren clay and ruins it as farming land for years to come.

In 1934 and 1936 wind erosion stripped earth from thousands of square miles of rich farm land and pasture. The region from the Panhandle of Texas north to the Dakotas was nicknamed the Dust Bowl. Starting in 1951 drought again became so severe that, by 1955, some 13 million acres were "dusted out." That was almost equal to the area of West Virginia. The drought struck most heavily in Wyoming, Colorado, New Mexico, Nebraska, Kansas, Oklahoma, and Texas.

This wind-driven topsoil may become heaped up elsewhere and compacted into firm deposits, called *loess*. Loess makes excellent soil wherever formed. But usually the dust is spread too finely to benefit other land, and much of it is carried by wind and streams to the ocean, where it is lost forever to the land. Meanwhile, if the subsoil is sandy at the site of the damage, the wind may set in motion great heaps of it, called dunes. Such rolling dunes may bury good soil or even farm buildings (*see* Sand).

Grazing land may be ruined by drought in much the same way. If a stockman tries to feed too many animals on his land or to feed the usual number in a year of deficient moisture, the excessive grazing destroys the tender new shoots of grass, and eventually the roots as well. Then wind erosion can start its harmful work.

When rainfall comes again, it increases the damage. The coverless land cannot resist the wash of water that drains toward the streams. The topsoil is undermined in sheets (*sheet erosion*), and soon gully erosion, along lines of the greatest drainage, cuts the land and makes plowing and planting impossible. (*See* Conservation.)

Droughts also cause enduring injury by lowering the level of the underground water supply, called the *water table*. Under normal conditions, the water table is near enough the surface so that plants having long tap-roots can draw upon it. Other plants can obtain moisture from a higher level of soil, which is kept moist by rain and by capillary attraction of water from the water table. But when rain does not come, the water table sinks, the soil above it becomes completely dry, and plants lose their last chance of getting water. Also, as the water table falls, wells go dry, navigation and city water supply dependent upon streams suffer from lowering of water in the streams, and sewage disposal in streams becomes difficult.

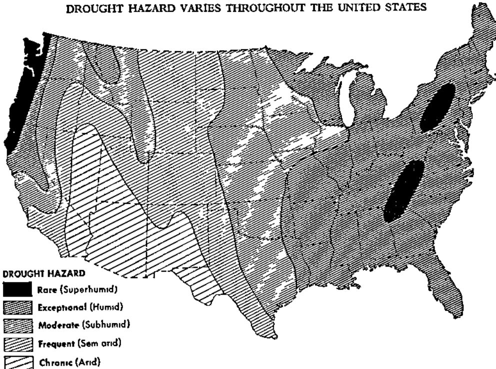
Government Measures to Combat Drought

Ever since the Far West was settled, the government has been more or less active in fighting losses due to drought. One of its earliest measures was finding drought-resistant food plants which could be grown with reasonable safety in regions where rainfall might be deficient. Expeditions went as far as the great dry plateaus of Tibet to find such plants. Kanred and durum wheat are among the results of the search (*see* Wheat).

Persistent efforts were made to train farmers in wise use of land in areas subject to drought. Wind and water erosion can be held in check by plowing, or *listing* with a combined disk and plow, in such fashion as to leave good furrows on the ground, instead of disking the surface to a powdery fineness. The furrows catch soil as it starts to blow, and also catch surface water, especially if the furrows on sloping land are plowed horizontally, so that each furrow is level throughout its whole length and lies squarely across the path of the water as it starts to drain downhill. This is called *contour plowing*.

Farmers were urged not to undertake too ambitious programs, or to contract debts which could only be paid off by getting continuously good crops. Unfor-

DROUGHT HAZARD VARIES THROUGHOUT THE UNITED STATES



Farmers must expect drought at some time or other in all but a few parts of the United States In general as one travels from the Atlantic coast to the Rockies the possibility of drought increases Growing crops involves little drought risk in the superhumid Northwest the Appalachians the humid East or the arid Southwest In these regions drought seldom occurs or it is so common that farming is attempted only with irrigation However, drought is a serious problem in the semihumid Middle West and in the semiarid Great Plains because drought years are so often mixed in with moist years of plentiful rainfall.

tunately, the government in the first World War urged farmers to grow wheat in the drought zone After the war the farmers remained and tried to make a living on land fit for cultivation only at wartime prices or with the help of unusually favorable weather

The government's preventive measures and the farmers' precautions did not come in time to prevent distress in the droughts of the 1930 s In those years the government devoted most of its efforts to measures intended to lessen immediate hardship

Emergency Relief and Permanent Policies

Loans were made to farmers who were in temporary difficulty to help them maintain their live stock and to plant crops the following year Live stock was bought and slaughtered for relief use or shipped to greener pastures The necessary minimum of feed for live stock was shipped into stricken areas

Farmers hopelessly in debt were given direct relief or work relief Much of the work relief consisted of building dams to stop erosion and to conserve ground water, creating artificial lakes to increase the available water supply planting trees digging wells and arranging supplementary irrigation canals (*see* Irrigation and Reclamation)

As part of the program for the future farmers on *submarginal* farms or farms which even in good years did not return a profit, were helped to find better locations The abandoned farms were returned to grass for grazing planted with trees or turned into wild life refuges (*see* Conservation) All these measures were part of a broad program to restore conditions that would protect the land from the related ravages of drought flood and erosion—ravages which might if left unchecked destroy in time the fertility of America s great farming regions

In the 1930 s the Great Plains Agricultural Council was established with headquarters at Manhattan Kan It is made up of federal state and land grant college officials Its purpose is to form a long range program for agriculture on the Great Plains

Congress in 1938 created a Federal Crop Insurance Corporation Through it a farmer may insure his crops against such natural hazards as drought but some cannot afford to pay for such protection In 1954–55 the government again gave emergency aid to farmers in the drought areas In 1955 the Secretary of Agriculture called a meeting of governors of the Dust Bowl states to work out long range recovery plans Until such a program can be carried out the only way for the individual to avoid drought loss is to avoid cultivating land subject to drought or to use suitable farming methods for that land

DRUGS. Helpful materials that go into medicines are called drugs. These used to be chiefly crude vegetable extracts or mineral salts. Doctors prescribed them without knowing much about how they worked or how large a dose to give. But in the 19th and 20th centuries, the science of drugs developed along with chemistry. Scientists learned to separate vegetable, mineral, and animal materials into their various parts and to identify the part that acted on the body—that is, they isolated the *active principle.* Then they made many tests, often on animals, to learn exactly how much of the principle produced the desired effect. This enabled them to make pure drugs of known strength.

Scientists also studied the chemical structure, or formula, of the active principles of drugs. Knowing the formula helped them to understand the action of a drug. Sometimes it enabled them to *synthesize* (make) the drug. This term comes from the Greek words *syn,* "with," and *tithenai,* "to put." When a chemist synthesizes a drug he puts together the chemical elements or compounds needed to make it. If he can do this he does not have to depend on nature to make the drug.

Some synthetic drugs are exact copies of the active principle in a natural drug. Synthetic adrenalin is an example. Adrenalin, or epinephrine, is the active principle of a certain part of the adrenal gland. It stimulates the heart and sympathetic nervous system. Synthetic adrenalin is a copy of this active principle and has the same effect.

Some synthetic drugs are substitutes rather than copies. They often improve on the original. Procaine hydrochloride (commonly called novocaine) is a better local anesthetic than cocaine. Certain synthetics, including the sulfa drugs, are not substitutes or copies but are drugs invented by man.

As a rule, synthetic drugs change less than natural drugs with age and changes in temperature. They are cheaper to make. They do not require plants from foreign lands, or rare minerals, or animal products.

Doctors usually classify drugs according to their effect on the human body. *Narcotics* deaden pain and produce sleep. *Anesthetics* cause loss of consciousness when general and deaden sensation in a given area when local. *Sedatives* and *hypnotics* calm nerves, reduce pain, and induce sleep. Antiseptics, germicides, and antibiotics fight infection. Doctors often group them as *anti-infectives. Hormone* preparations are extracts of animal glands or of gland secretions, or synthetic substitutes. They act like the hormones produced by human glands. *Antipyretics* prevent or lower fever.

The drugs of recognized value and known composition in America are listed in the 'United States Pharmacopeia', designated as the legal standard by the Pure Foods and Drugs Act of 1906. All drugs prepared according to the formulas of the 'Pharmacopeia' bear the stamp "U. S. P." upon box or label. Few drugs, however, should be employed except on a physician's advice. Only a small number are *specifics*—that is, adapted to cure or prevent some special disease as quinine cures malaria—and most of them are injurious if taken in large quantities or for long periods. (*See also* Anesthetics; Antiseptics; Narcotics.)

DRUM. Probably the drum is the oldest musical instrument. Primitive tribes still use drums to call the warriors together for battle, to keep time for singing and dancing, and to accompany religious ceremonies. Such primitive drums are often logs hollowed out and slit down one side. Drums of the civilized world, however, all have at least one *head* made of the dried skin of an animal. Vellum, made from the skin of a young calf, is the best.

The drums of orchestras and bands fall into three classes: first, those made of a single skin stretched over a frame which is open at the bottom, such as a tambourine; second, those in which the skin is stretched over a closed vessel, such as the kettledrum; and third, those having two heads, one at each end of a cylinder, such as the bass drum.

The kettledrums, or *timpani,* are the most important in the orchestra today. Vellum is stretched over a hollow hemisphere of metal; the skin is held in place by a ring that can be tightened or loosened by means of screws so as to raise or lower the pitch Kettledrums are played in pairs, tuned to the tonic and dominant notes of the scale. Three kinds of drumsticks are used: one with sponge tips for soft strokes, one with leather tips for medium, and one with wooden tips for loud, sudden tones.

The bass drum and the snare drum do not produce tones of any definite pitch. The booming thud of the bass drum marks the rhythm and emphasizes climaxes Certain types of jazz music make use of the bass drum with *traps*—noisemakers such as cymbals, wooden blocks, and tom-toms. The snare drum is so called because *snares* of catgut string or wire are stretched across the lower head to make the tone more brilliant. In the orchestra the stirring roll of the snare drum is often used in crescendo passages. The military drum, or street drum, is a snare drum much used in marching bands. (For pictures of drums, *see* Musical Instruments.)

DRUMMOND, WILLIAM HENRY (1854–1907). The wild rugged beauty of Canada, and the spirit of romance and adventure, now fast disappearing, will always remain fresh and living in the verses of the Canadian poet-doctor, William Henry Drummond Above all he has caught the spirit of the *habitant,* as the French-Canadians of the farms, woods, and lumber camps are called. He has made these simple hardy people speak in their own French-English dialect, making them all the more real and lovable through their broken speech and revealing the true heart beneath the rough exterior.

Born in County Leitrim, Ireland, Drummond was taken to Canada by his parents when a boy. He worked for a time in the telegraph service at Bord-à-Plouffe (Quebec province) in the center of the lumber trade, and there for the first time came in contact

with the *voyageur* and the *habitant* When, after his graduation from McGill University and Bishop's Medical College, he entered upon the practice of medicine, he chose a little community in which there were many of the French-Canadians, together with Indians and half-breeds Robust and athletic, fond of sport and of outdoor life, he delighted in the companionship of the people who lived close to nature He won their friendship by his sympathy and understanding, as well as by the multitude of good deeds for which he, as a country doctor, found opportunity Afterwards Dr. Drummond became Professor of Medical Jurisprudence at Bishop's College in the same province, and won many honors, but his proudest title remained simply "*Habitant* Drummond "

Drummond s poetical works appeared in the following volumes 'The Habitant and the French-Canadian Poems (1897), 'Phil o-rum s Canoe and Madeleine Vercheres' (1898); 'Johnnie Courteau and Other Poems (1901) The Voyageur and Other Poems (1905) 'The Great Fight (1908)

DRYDEN, JOHN (1631-1700) One day near the close of the 17th century a little lad was brought to Will s Coffee House in London, the great gathering place for literary men, to gaze upon the greatest writer of the time That little lad was Alexander Pope, and that great man, whose ideas of poetic composition he was to follow and carry still further, was John Dryden,—poet, critic, and essayist

Dryden taught that correctness, polish, and elegance, rather than originality, imagination, and feeling, were the essentials of good poetry He chose the regular heroic couplet (two lines of iambic pentameter rhyming together) as "fittest for discourse, and nearest prose " His age was indeed an age of prose, and although he exerted a great influence on the poetry of his own period and the one which followed, his most permanent influence in English literature has been not in poetry, but in prose. Indeed modern English prose style may be said to begin with Dryden, and although we no longer place him with the first of the poets, he is still regarded as a great critic

Many of his lines have passed into the currency of everyday speech, as for example

None but the brave deserves the fair
Men are but children of a larger growth
Few know the use of life before 'tis past
Great wits are sure to madness near allied

Born in the little village of Aldwinkle in Northamptonshire, he came of Puritan stock, and his first important poem was an elegy on the death of the Puritan leader Cromwell, but he turned Royalist and welcomed King Charles II with another poem, 'Astraea Redux' Later he also changed to the Roman Catholic faith, which he defended in an allegorical poem, 'The Hind and the Panther'.

For a long time Dryden wrote only plays—bombastic heroic tragedies, and comedies which reflected the low moral tone of the day He also wrote several personal and political satires, of which 'Absalom and Achitophel' is the most powerful in English literature He made translations from the Greek and Latin classics, and wrote a number of critical essays in the form of prefaces to other works But of all his works, his beautiful odes, 'Alexander's Feast' and 'A Song for St Cecilia's Day', are the favorites today.

DUBLIN (in Gaelic, *Baile Atha Cliath*), IRELAND Battles and sieges riots and rebellions crowd the long story of Dublin, the capital and largest city of the Republic of Ireland The story is filled also with the names of great men—Wellington Swift, Steele, Moore Sheridan, Emmet, O'Connell, Parnell, and scores of others Dublin has been the nursery of Irish genius from the early centuries of the Christian Era

It is a spacious and leisurely city, with stately old mansions, splendid public buildings, and wide green squares But for a city of its size and importance, its industries are few Politics, literature, and social activities have occupied the attention of its inhabitants rather than commercial pursuits Brewing distilling textile manufactures, ship-building and the exporting of farm produce are the chief industries

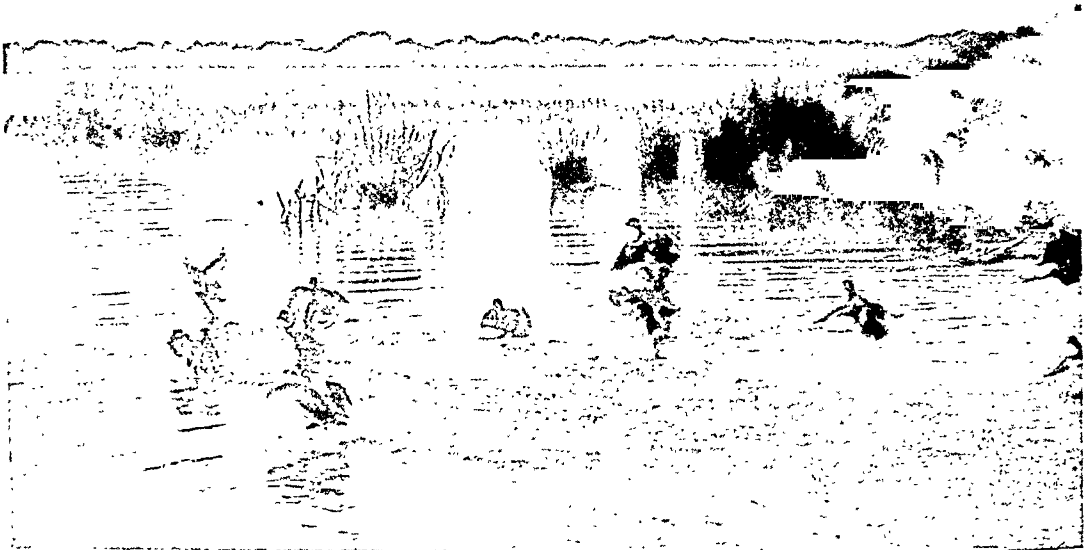
Dublin lies near the center of Ireland s east coast at the foot of the high rugged promontory of Howth In the heart of the city is the 20-acre park called St Stephen's Green A short trip thence brings you to O'Connell Bridge, one of a dozen bridges over the Liffey River, which cuts Dublin from west to east The river is lined on both sides by massive quays nearly all built of granite

O Connell Bridge links the famous 120-foot wide Sackville (or O Connell) Street on the north side of the Liffey with the district to the south where lie many of the shops and public buildings Here are the huge colonnaded semi-circular Bank of Ireland, formerly the Irish Parliament House, and the large group of buildings comprising the University of Dublin The aristocratic section comprises much of the eastern half of the city, toward the bay In dismal contrast to its mansions and splendid squares and terraces is the squalid slum district, with its crooked streets and wretched hovels, in the southwestern part of Dublin

Among the historic buildings the chief is the Castle originally built in the 13th century and formerly the seat of the Irish government Notable also are the Protestant churches, St Patrick's Cathedral and Christ Church St Patrick's though in a poor section of the city, is a magnificent Gothic structure commenced between 1220 and 1260 Its most famous dean was Jonathan Swift Christ Church, in the early English Gothic style, was founded in 1038 by a Danish king of Dublin There are many beautiful Catholic churches and numerous monuments and statues

Many of Dublin s finest buildings were wrecked in the revolt of 1916 when an Irish republic was proclaimed in expectation of German aid to be brought by Sir Roger Casement and in the rebellion of 1922 Nearly the whole of Sackville Street was reduced to ruins Phoenix Park a magnificent wooded area of 2 000 acres with great herds of deer is just outside the city It was the scene in 1882 of the assassination of the chief secretary for Ireland and his undersecretary Population (1951 census) 523 183

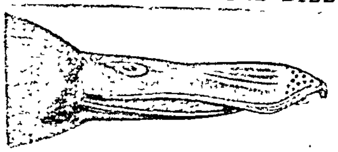
A FAVORITE *among* BIRDS *the World Over—The* DUCK



Ducks are known the world over as expert fliers, swimmers, and divers. Here a flock is pattering over the surface of a pond preparing to take off. The picture shows the type of marshy waterway which certain ducks like for their home.

DUCK. A familiar sound of nearly every farm and barnyard is the quack-quack-quack of the ducks. Their clumsy waddle on land is a contrast to their easy grace in the water and the speed and beauty of their flight. Flocks of wild ducks winging their way southward in the autumn mean that winter is drawing near and the hunting season is open. Both wild and domestic ducks are valued for their delicious flesh. They are also raised for their eggs and for their down.

A DUCK'S SIEVELIKE BILL



The fringe on the bill of some ducks strains out water but holds food.

Mallards, wood ducks, and a few others nest and raise their young throughout North America. But most of the wild ducks breed from the Canadian border states to the limit of trees in the Far North. The Central and Southern states know them chiefly as winter residents. Some of them migrate to Mexico and Central and South America. Their stay in the South is brief. As soon as the ice breaks up in the northlands, they start "back home" again—to woodland pond and forest-bordered stream, marsh, lake shore, and seacoast.

Ducks are well dressed for a life in icy waters. The outer coat of closely packed feathers is made waterproof by oil from a gland near the tail. Beneath this coat is an inner dress of thick down. The webfeet have no nerves or blood and so do not feel the cold.

The male bird, called the drake, has showy plumage. The female, known simply as a duck, wears feathers of dull brown barred with black. The wing patch, called the speculum, is usually colored. The duck's feet and legs are set far back on the body. This position is an advantage in swimming, but it makes the bird extremely awkward when it walks on land. It is an expert swimmer and diver, and in short flights it holds a speed record of 70 miles an hour.

Most ducks nest on the ground, near water, in a hollow lined with fine plants and down from the birds' own breasts. The down is used to cover the eggs when the female is away from the nest. Only the female incubates the 6 to 14 eggs. The ducklings take to the water as soon as they hatch.

"TIP-UPS" FEEDING

Some ducks, like the mallards, feed under water by tipping upside down, feet and tail waving in the air.

Canvasbacks and redheads attach their nests to reeds over the water. Wood ducks, goldeneyes, and buffleheads nest in hollow trees as much as 40 feet above the ground. Encouraged by their parents, who cluck softly to them from below, the ducklings "parachute" out of their lofty nests. Then in single file they form a procession to the water.

After the breeding season ducks molt or shed their feathers. At this time they cannot fly because they lose all their wing quills at once. (Strictly flying birds lose only one quill at a time from each wing.) While the ducks are in their temporary or eclipse plumage they are dull colored and remain quiet in order not to attract the attention of their enemies.

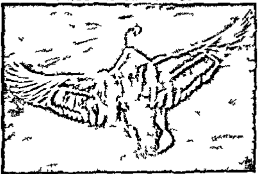
There are about 160 species of ducks throughout the world in every continent except Antarctica. About 40 species occur in North America. Scientists separate them into two main groups—surface-feeding and diving ducks. The distinction is based mainly on habits and food, although there are some differences in body structure. The diving ducks have a large lobe or web on the hind toe of the foot. In the surface feeders this lobe is absent and only the three front toes are webbed.

Surface Feeding Ducks

The surface-feeding ducks live in marshes, shallow ponds and bays, and slow moving streams. They dive very little. Instead they feed by tipping up, head down, feet and tail in the air, and probing the mud bottoms for shellfish and insects. Or they dabble in the water for floating duckweed, the seeds and roots of other water plants, and insects.

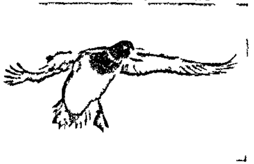
Mallards are the most numerous of the surface-feeding ducks. They are *found in all parts of the* Northern Hemisphere. Many of the domestic ducks of North America and Europe are from mallard stock. From earliest time this bird has furnished mankind with appetizing food. It is the chief water fowl of most game preserves. In some of which 10,000 birds are reared every year. The drake has a glossy green head and a white ring around the neck. Its back is grayish brown, the breast rich chestnut, the under parts grayish white finely marked with wavy black lines. The speculum is purple. The female mallard is mottled brown with purple wing patch. (For pictures in color see Birds; Egg.)

MALLARD TAKING OFF



The mallard springs up from the surface of the water with a heavy thrust of the webbed feet and with rapidly beating wings.

COMING IN FOR A LANDING



With feet lowered, wings and tail feathers outspread to slow its speed, the mallard is preparing to land on the water.

The blue-winged, green-winged, and cinnamon teal are the bantams of the group—about one third smaller than the mallard. They too are highly prized as food. The black duck, often called black mallard, is not actually black but a dark brown streaked with black. In flight the bird shows silver wing linings. Shoveler or spoonbill is the name given to a species with a clumsy spoon-shaped bill. Like the mallard it has a green head. The wing patch is green, the under parts and sides chestnut. The wood duck is the family beauty. The drake is green, blue, and purple with white streaks above and red, yellow, and white below. The head is marked with a white line and has long white crest feathers. The female is brown above and yellowish brown beneath.

AT REST ON THE QUIET WATERS

The male mallard is a beautiful bird with glossy green head, chestnut breast, purple wing patch, brownish gray back, and black and white tail.

Baldpates are so named because of their white crowns. The pintail is easily identified by the long central tail feathers, glossed with green, and the narrow white line up the side of the neck and head. The female also has sharply pointed central tail feathers but they are not so long as the male's. The gadwall is a dark bird with buffy head.

Ducks That Dive for Their Food

Diving ducks live on the open waters of large lakes and seacoasts. They dive for their food of fish, shellfish, and water

plants. They feed by day and spend the night on the water far from shore. Diving ducks nest farther north than the surface feeders, to the limit of trees in the sub-Arctic. They winter throughout the United States. A few journey to Central America.

These birds are truly deep-sea divers. On the Great Lakes, ducks called old squaws have been brought up alive in fish nets from a depth of 160 feet. Some authorities believe that they can dive as far as 240 feet. According to one observer, old squaws, scoters, and eiders use their wings in diving; others seem to use only their feet.

Before going under water, diving ducks apparently expel the air from their body cavities. In addition, they further reduce their buoyancy by contracting the feathers and pressing out the air enclosed in them. They are able to stay under water 70 to 90 seconds and have been known to survive under water for three minutes During that time the bird reduces the blood flow to the muscles, reserving the supply mainly for the central nervous system It uses oxygen stored in the blood stream and in the muscles.

Some Well-Known Divers

The canvasback is probably the best known of the diving ducks It is so named because its compact, grayish-colored back resembles coarse canvas. Its head and neck are red-brown This bird is highly prized by hunters. Its delicious flesh is at its best when the bird has been feeding on wild celery or upon the wapatoo, a bulblike root which it finds in the Western states It is a hardy bird, and on its autumn migration reaches the United States late in October. It may remain in the Great Lakes region until driven out by ice. Closely related to the canvasback is the redhead.

In the central and southern United States, the American goldeneye, or whistler, the scaup, or bluebill, and the old squaw are the common winter ducks of large bodies of water. The male old squaw, like the pintail, has very long, pointed central tail feathers The male in summer plumage is beautifully patterned in black and white. It becomes a mottled brown and white in winter plumage. The odd name "old squaw" is said to be due to the ceaseless chatter of the flocks while they feed.

The scaup may be recognized by its black head, breast and tail, and white body. The goldeneye, also a black and white bird, has a high, almost triangular head of dark, glossy green, with a large round white spot between the eye and the bill. The rare Barrows goldeneye, a native of western North America, has a crescent-shaped white spot on a dark purple head. The goldeneye is known to hunters as the whistler, because of the whistling sound made by the swiftly beating wings.

Rare Ducks of the Far North

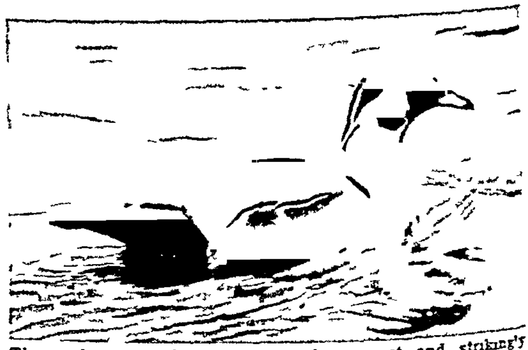
A duck seldom seen in the United States, even in the winter, is the eider. It is beautifully patterned in black and white. Eider ducks are native to both northern Europe and America. They are especially valued for their down and their eggs. The female pulls down from her breast and makes a padded blanket that

SOME FAVORITE DUCKS OF

The goldeneye may be recognized by the white spot between the eye and the bill on the dark green, triangular-shaped head.

The ring-necked duck resembles the scaup. The white point on the side distinguishes it. The red collar is not seen at a distance.

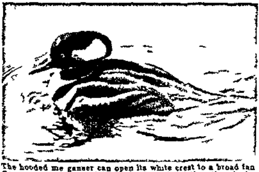
Blue-winged teal are beautiful little surface feeders. The white crescent on the head and the vivid blue wings identify it.



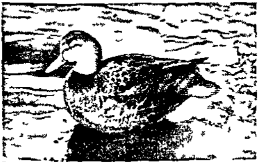
The male wood duck, with its long crest and strikingly patterned face, is also the most vividly colored of all the ducks.

SPORTSMEN AND BIRD LOVERS

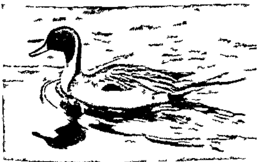
The scaup or blue bill is a favorite target of hunters. Note how it resembles the ring necked duck on the opposite page



The hooded merganser can open its white crest to a broad fan. Compare the cylindrical bill with the bills of the other ducks



The black duck or black mallard is a mottled dark brown bird in spite of its name. Seen from below it is black with silver wings



The pintail is easily recognized by its long greenish tail feathers and white line up the neck and head. The wing patch is also green

completely covers the nest. If the down and eggs are removed she relines the nest and lays more eggs repeatedly. Commercial eider down is now taken only from the nest and not by killing the bird as in the past. In Canada, where the birds breed, and in some parts of Europe, down collecting is supervised by game wardens.

Mergansers are fish-eating divers which scientists place in a separate subfamily. They are also called sheldrakes or goosanders. They differ from all other ducks in having a long, narrow, cylinder-shaped bill with saw-tooth edges. The American and the red-breasted mergansers are common winter ducks that are found on large lakes and along the seacoasts of the United States. The beautiful hooded merganser, with its great white fanshaped crest, prefers quiet ponds and lakes and winters farther south. Mergansers are not hunted because their flesh has a disagreeable fishy flavor.

Conservation of Wild Ducks

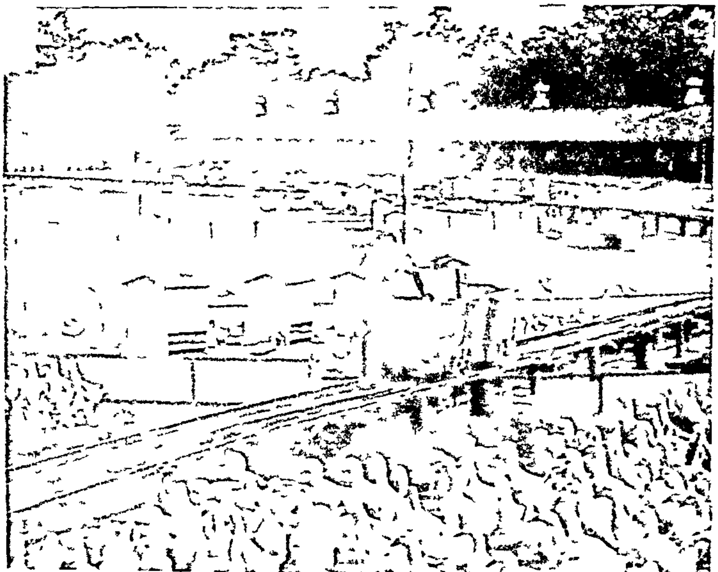
Once hundreds of millions of wild ducks lived on the marshes and waterways of North America. The settlement of the continent destroyed millions of acres of their breeding and feeding grounds. Drought and flood in recent years and excessive hunting have further greatly reduced their numbers. In 1946 the total number of waterfowl fell from 80 000 000 to 54 000 000 birds. Of these 85 per cent were ducks, the remainder geese and swans. It has been estimated that if every family in the United States had wild duck for dinner on two successive Sundays the wild ducks would become extinct.

The Federal Fish and Wildlife Service in the Department of the Interior regulates hunting in order to save the birds from extermination. Every year the service takes a census of the birds on their wintering grounds. This is done by means of aerial photographs and also by estimated counts from the ground. If the numbers are dangerously low the government reduces the bag limit and shortens the hunting season. Shooting of certain species may be prohibited entirely until they show an increase. The individual states may further restrict hunting at their discretion but they may not *increase* the bag limit set by the Federal government.

All hunters are required to purchase federal duck stamps as a license to hunt. The money is used to purchase and maintain refuges for waterfowl and to enforce the laws. In 1937 the Pittman Robertson Federal Aid to-Wildlife bill appropriated to the individual states the excise tax of 11 per cent on sporting arms and ammunition. This money also is used for the support of refuges.

A nonprofit organization of Canadian and American sportsmen called Ducks Unlimited was formed in 1937 to increase the number of waterfowl. It has concentrated on restoring marshes in the principal breeding areas in Saskatchewan, Alberta and Manitoba. Farmers donate the use of their land and the association finances the building of dams to create shallow lakes with bordering marshes. Not only are

A LONG ISLAND DUCK FARM



These white Pekin ducks will be shipped to poultry markets and restaurants throughout the country. Suffolk County in Long Island, New York, is the "duck capital of the world." A farm like this one raises tens of thousands of birds.

the ponds used by the ducks but they provide water for cattle and fish for the farmer's table.

Raising Ducks on Farms

Ducks are raised commercially and for home farm use. They are hardy and comparatively free of disease and insects. They need only the simplest housing and get along well without water to swim in. The eggs are easily hatched under hens. The young grow fast and require little care.

On the commercial duck farms of Long Island, New York, some six million ducks are raised in a year—about one-half the total production of the United States. Most of the birds are white Pekins, first introduced into the United States from China about 1870. Other popular breeds are the mallard; the white Aylesbury, another Chinese bird; and the Muscovy, native to Mexico and South America. The Muscovy is larger than the mallard and has a small crest and fleshy red growths about the head and eyes.

How Ducks Are Classified

Ducks belong to the family *Anatidae.* The family includes the swans and geese. These ducks are grouped in five subfamilies: surface-feeding ducks, *Anatinae,* include the mallard, black duck, gadwall, European widgeon, baldpate, pintail, green-winged, blue-winged, and cinnamon teal, shoveler, and wood duck; diving ducks, *Aythyinae,* include the canvasback, redhead, ringnecked duck, greater and lesser scaup, goldeneye, bufflehead, old squaw, harlequin, Labrador, eider duck, and American, surf, and white-winged scoters; the mergansers, *Merginae;* the ruddy and masked ducks, *Oxyura,* of which only the ruddy duck ... America north of the Rio Grande; and the tropical tree ducks, *Dendrocyginae,* which do not occur in the United States.

DUCKBILL. One of the strangest animals in the world is the duckbill platypus. It has a beak like a duck, dense fur, and a wide flat tail. It lays eggs and hatches them like a bird, but feeds its young with milk like a mammal. It has four legs and webfeet, and lives both on land and in the water.

British scientists who saw a stuffed specimen for the first time in 1799 declared it a clever fake. Almost one hundred years went by before the eggs were discovered in 1884. The find convinced scientists that such a creature actually existed. It was given the scientific name *Ornithorhynchus anatinus,* meaning "bird beak like a duck." The popular name platypus comes from two Greek words meaning "flat foot."

The duckbill lives in the rivers and streams of eastern Australia and Tasmania. A full-grown duckbill measures about 20 inches from tip of bill to the end of the tail and weighs about four pounds. The short fur is dark above and silvery-gray on the belly. The eyes are small. There are no external ears. The nostrils are near the end of the soft, rubbery bill. Thus the duckbill can remain hidden under water and breathe with only the tip of the bill exposed. The forepaws are webbed for swimming. When the animal walks on land the webs fold under the palm of the foot and expose the claws. The legs are short and the gait is clumsy.

AN "IMPOSSIBLE" CREATURE

The duckbill is a queer animal. It has a beak and webfeet like a duck, milk glands like a mammal, and poison glands like a snake.

The voice of these curious animals is like the growl of an angry puppy, but they are exceptionally timid.

The duckbill feeds by night, probing in river bottoms for earthworms, crayfish, and water insects. At daybreak it crawls into a grass-lined nest, deep in some mud bank, through an underwater entrance. The female lays from one to three, but usually two, soft-shelled eggs about the size of pigeon eggs. She incubates them by holding them against her body with her tail. The embryos are partly developed when the eggs are laid and hatch in seven to ten days. The young lap up the mother's milk as it exudes from

milk glands There are no teats The young are born with teeth but these soon fall out Then the animals use tough horny plates on the sides of the bill

The male duckbill is the only poisonous mammal in the world It has on its hind legs grooved spurs connected by long tubes with poison glands situated near the thighs The poison closely resembles snake venom Probably the male uses it in fighting with other males during the mating season Duckbills are rarely seen in zoos for it is extremely hard to keep them alive in captivity

A land-dwelling relative of the duckbill is the echidna or spiny anteater a native of Australia and Tasmania and also found in New Guinea It has quills like a porcupine and a long tubular snout It too lays eggs and feeds its young with milk The eggs are hatched in a pouch on the mother s stomach like the pouch of a kangaroo The animal burrows in sand or hides in rock crevices

Both the duckbill and the spiny anteater belong to the order *Monotremata* the lowest order of the class *Mammalia* Scientists consider them primitive types of creatures related to both reptiles and the earliest mammals For this reason they have often been called living fossils They are *not* a link between mammals and birds That these animals should be found only in the Australasian region is explained by the theory that these lands became separated from their neighbors long ages ago

DULUTH' MINN The country s next greatest port after New York is not on any ocean It is the harbor of the twin cities Duluth in Minnesota and Superior in Wisconsin at the western end of Lake Superior

Here is the nation s great center for shipping out Minnesota s iron ore and the wheat crops of the northwest and receiving coal More than 9 000 shiploads carrying from 50 to 70 million tons of these commodities are moved every year In peak years the port has handled about 75 million tons It is so well equipped that every vessel is unloaded loaded and on its way within a few hours In the railroad yards long trains of freight cars are handled with the same speed and efficiency

The harbor is admirably suited for its gigantic task Its surface of 19 square miles is protected from lake storms by Minnesota Point projecting seven miles southeastward from Duluth and Wisconsin Point jutting northwestward from Superior Between the points is the channel of the Superior Ship Canal another channel cuts across Minnesota Point There are 21 huge coal docks 7 iron-ore docks 23 grain elevators, and nearly 50 other wharves (*see* Great Lakes)

Beyond the harbor Duluth rises on terraced bluffs It is a year round vacation center with a healthful climate scenic attractions and recreation facilities Lake Superior tempers summer heat and winter cold The city is also a haven for those seeking relief from hay fever and asthma Parks and boulevards include the 27 mile Skyline Parkway along the heights above the city Another point of interest is the Aerial Lift Bridge over the Duluth ship canal Its central span rises 120 feet in 50 seconds to allow large vessels to pass Manufactures include iron and steel products electrical equipment and wood products

Among the city s schools are the Duluth branch of the University of Minnesota Duluth Junior College and College of St Scholastica Cultural facilities include Duluth Public Library *Children s Museum* and Art center Duluth Zoo Darling Observatory Duluth Symphony Orchestra Duluth Playhouse and St Louis County Historical Society Museum

Duluth was named for Daniel Greysolon Sieur du Lhut a French explorer who reached Lake Superior in 1679 The first permanent settlement was made in 1853 After 1880 the city grew rapidly with the development of iron mining and the extension of railroads into the Northwest The commission form of government was adopted in 1912 Population (1950 census) 104 511

DUMAS (*du-ma*) ALEXANDRE (1802–1870) Robert Louis Stevenson once said that a quiet evening spent under a lamp with Dumas s The Viscount de Bragelonne was not a silent one because the book was filled with such a clatter of horse-shoes and such a rattle of musketry and such a stir of talk Alexandre Dumas s works are among the most widely read of all books They are so filled with breathless action and clever talk that the world s readers read and reread them Yet critics have said his writings are outside of literature because they are often carelessly written and inaccurate historically

Alexandre Dumas was born July 24 1802 in a small town near Paris His father one of Napoleon s generals was the son of a French aristocrat and a Haitian slave *His mother was the daughter of an innkeeper* Thus Dumas was one-quarter Negro The general died when the boy was about four The mother was unable to give Alexandre much education and while still young the boy became a lawyer s messenger When Dumas was 20 he worked in Paris as a junior clerk in the estate office of the Duc d Orleans who later ascended the French throne as Louis-Phillippe

Dumas s love affair with a seamstress resulted in the birth of Alexandre Dumas the Younger on July 28 1824 when Dumas was only 22 Dumas was interested in the drama After several failures one of his plays Henri II was produced on the Parisian stage Its success was great and from his obscure position as a clerk Dumas leaped into the limelight as one of the leaders of the Romantic movement Most of his plays some of which were comedies were successful In the 1840 s Dumas turned most of his efforts to writing swashbuckling historical novels His modern reputation rests principally on these the best known of which are Les trois Mousquetaires (The Three Musketeers) 1844 Vingt ans après (Twenty Years After) 1845 Le Comte de Monte Cristo (The Count of *Monte Cristo*) 1845 and Le Vicomte de Bragelonne (The Viscount de Bragelonne) 1850

Dumas wrote many plays novels essays and travel books The demand for his work was so great that Dumas needed several collaborators (a not uncommon

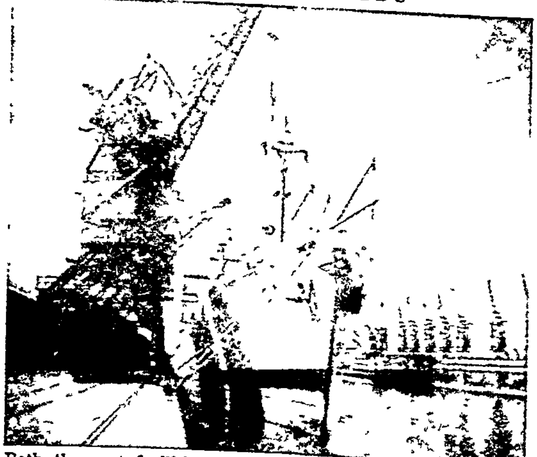
practice of his time). These collaborators would do research, plot the stories, and write the chapters. Dumas would go over their work, adding here and there, changing the plot and characters to give the works that charm and movement that made his novels popular. Their names never appeared on the title pages of these works, but this omission was also a practice of the day. Dumas earned vast sums, but he spent money faster than he earned it. His wish to be elected to the French Academy was never fulfilled. He died in near poverty on Dec. 5, 1870.

ALEXANDRE DUMAS THE YOUNGER (1824–1895) as a dramatist achieved a high place in French literature. Unlike his father he was elected to the French Academy (1874) and he died a wealthy man. His best-known play, taken from his novel 'La Dame aux camélias' (The Lady of the Camellias), was made famous in America by Sarah Bernhardt under the title 'Camille'. Verdi's opera 'La Traviata' was also taken from the younger Dumas's novel. Many of the younger Dumas's plays deal with marriage reforms and morals. He died Nov. 27, 1895.

DUN'KIRK, FRANCE. An important commercial seaport, Dunkirk lies in the extreme north of France on the Strait of Dover. The town was demolished in the evacuation of Dunkirk, one of the great actions of the second World War. With the German breakthrough in 1940, King Leopold had surrendered Belgium on May 28. The French flank crumbled before a German advance which swept around the Allied armies in the north. Britain's only army was caught between the sea and the thrust of Hitler's panzer units.

On the Dunkirk beaches, the British, with some French and Dutch units, stood almost helpless. They would have been destroyed but for the small Royal Air Force, which held off the German planes, taking a toll of four for one. From May 29 to June 4, an improvised armada, mostly of small volunteer craft, crossed the channel and evacuated 335,000, or three fourths, of the Allied forces in the face of a frightful artillery bombardment. This was a turning point of the war (*see* World War, Second).

DUNKIRK REBUILDS



Both the port facilities and the buildings of Dunkirk were almost totally destroyed during the second World War. Since the war the city and harbor facilities have been restored.

The name Dunkirk (French *Dunkerque*) means "dune-church." It is said that St. Eloi founded a small church, or "kirk," here on the sand dunes in the 7th century and that around this the city grew. In the 10th century it was fortified by Baldwin III, count of Flanders. With Flanders it passed successively under the rule of Burgundy, Austria, and Spain. England held it for four years following 1658, but Charles II, needing money, then sold it to Louis XIV. It has since been a part of France.

Canals and railways link Dunkirk to the rich farm lands, coal mines, and factory centers of France and Belgium. By 1953 much of Dunkirk had been rebuilt and it resumed its chief industries—shipbuilding, shipping, fishing, iron founding, refining, and lace-making. Population before 1940, about 31,000; 1946 census, 9,869.

DÜRER, ALBRECHT (1471–1528). The son of an unimportant goldsmith, Albrecht Dürer was called the "prince of German artists." He was the first to fuse the richness of the Italian Renaissance to the harsher northern European arts of painting, drawing, and engraving (*see* Renaissance).

Dürer was the second son of a family of 18 children. He was born in Nuremberg, Germany, May 21, 1471 (*see* Nuremberg). Before being taken into his father's shop to learn goldsmithing, he was sent to school to learn reading and writing. His aptitude for drawing, however, led his father to apprentice him when 15 to a Nuremberg painter. Upon completing his apprenticeship in 1490, Dürer took the traditional young artist's trip to the art centers of Germany. In 1494, either just before or just after his marriage to Agnes Frey—the daughter of a Nuremberg merchant—he visited Venice. From that time forward the Italian influence was evident in his work.

Back in his home city, Dürer occupied himself with both painting and wood engraving. Paintings were costly, and they could be enjoyed only by the purchaser and his immediate circle. By using the new craft of printing, many copies of an engraving could be made. The printings were used to educate many people in religious and classical history (*see* Engraving and Etching).

In 1507 Dürer made another visit to Venice; he remained there a year and a half. After his return he seems to have renounced painting as an important work, and instead devoted most of his time to engraving on wood and copper. In 1513 and 1514 he completed his three best-known copper engravings: 'Knight, Death, and the Devil', 'St. Jerome in His Study', and 'Melencolia' (Melancholia).

Dürer also delved into the mathematics of proportions and perspectives and during his lifetime published two works on these subjects. He was a friend of Martin Luther and several other leaders of the Reformation (*see* Reformation). In 1520 Dürer visit-

ALBRECHT DÜRER

This is a self portrait of the German artist who brought new techniques to the art of engraving

ed the Netherlands. Everywhere he was acclaimed a great artist. He died in Nuremberg on April 6, 1528. (For reproductions of his engravings *see* Engraving and Etching; Dance; Drawing.)

DYES. To give pleasing variety to dress and other things used in daily life, men dye materials different colors. About 75 per cent of all dyes are used to give clothing and other textiles their many colors. The remaining 25 per cent are used to color paints, stains, varnishes, wallpaper, typewriter ribbons, inks, plastics, foods, paper, leather, rubber, gasoline, stove and shoe polishes, carbon paper, candles, colored photographic film, and many other things.

Early Dyes

Men used dyes to color drawings of animals on the walls of caves more than 25,000 years ago. An Egyptian mummy buried more than 5,000 years ago was wrapped in dyed strips of linen cloth. The earliest dyes were derived from animal, mineral, and vegetable sources. An early animal dye was the Tyrian purple that colored the imperial robes of the Roman emperors. This dye was extracted from a shellfish found in the Mediterranean. Another favorite dye was cochineal (scarlet); this was obtained from the bodies of tiny dried insects (*Coccus cacti*) found in Mexico (*see* Cochineal). Mineral dyes included oxides of iron, aluminum, manganese, and other metals.

The most used of all early dyes were *vegetable*. Vegetable colors can be boiled from the barks, seeds, stems, shoots, leaves, berries, and roots of plants, including lichens and mosses. The most-used dyes were obtained from indigo (for blues), *birch leaves* (yellows), madder (reds), logwood (blues, grays, dark reds, and blacks), and cutch (tans and browns). (*See also* Birch; Indigo; Logwood.)

The Coal Tar Dyes

Today most dyes are obtained from coal tar. In recent years dyestuff makers have called these dyes *synthetic organic colors*. The *crudes* from which dyes are made are obtained by heating coal in closed ovens (*see* Coke). Coal tar is driven off (*see* Coal Tar Products). Crudes may be had by heating the coal tar in retorts. Because various crudes boil at different temperatures, each crude is recovered by boiling the coal tar at its particular boiling point. When purified, these crudes are either colorless liquids or crystals. The crudes most used for making dyes are benzene, toluene, xylene, phenol, cresol, naphthalene, anthracene, methyl anthracene, phenanthrene, and carbozol. All are aromatic hydrocarbons containing the benzene ring (*see* Benzene; Hydrocarbons).

About 500 *intermediates* ("intermediates" because they are the products midway in the manufacture of dyes) are made from these crudes. The intermediates are combined with other chemicals such as sulfuric, hydrochloric, and nitric acids or with ammonia, alcohol, chlorine, or hydrogen. There are many ways to transform the intermediates into the variously colored dyestuffs. About 5,000 different colors have been synthesized, and of these about 1,500 are suitable for dyeing textile fibers.

The dyes have crystal forms. These crystals are ground fine in ball mills so that the dye will dissolve quickly (for picture of a ball mill *see* Cement). Dyes are sold in waterproof packages.

Why Dyes Color

Dyes color materials because of the arrangement of atoms within their molecules. The color heart of a dye is the *chromophore* (Greek for "color bearer"), which is made up of several atoms. Dye chemists think that there are 15 chromophores. Within the chromophore some electrons travel from one atom to another, adding energy to some and taking energy from others. Each shade of color has its own wave length (*see* Color). Atoms of a chromophore vibrate at the same rate as the wave length of a color and thus either reflect or absorb the colored light.

Mordants

Chemically, dyes may be basic, acid, or neutral. Basic dyes are attracted by and cling to the acid constituents of fibers. Acid dyes are attracted by and cling to the basic constituents of fibers. Neutral dyes need help to enter and cling to fibers. Because cotton and rayon goods have tougher fibers than wool and silk, some of the basic and acid dyes used to color them also need help. This help is given with mordants (a French word meaning "biting"). (*See also* Acids and Alkalies.)

The mordant material bites on to the fibers and, when dye is added, to the dye, thus bonding dye and material together in the same manner that mortar bonds bricks together. With some dyes the material to be dyed is treated with the mordant first; with others the mordant is incorporated with the dye. Mordants are metallic colloids (chemically, metallic hydroxides) for use with acid dyes and tannate colloids for use with basic dyes (*see* Colloids).

Applying Dyes

Broadly speaking, there are two methods by which fabrics are colored. One of these is by *dipping* the

material (either fibers, yarn, or cloth) in dyeing vats. The other is to run long lengths of fabric through a press that prints the color or colors in much the same way as a newspaper is printed.

Where a fabric is woven of more than one kind of yarn (for instance, acetate rayon and cotton), the fibers of one kind will refuse a dye that is accepted by the other. By using appropriate dyes, interesting color patterns and contrasts can be dyed into the fabric by dipping the cloth in different dyes to color the different types of fibers.

Batik dyeing originated in ancient times in Java. Silk and cotton are the fabrics most used. A wax (made of a mixture of beeswax and paraffin) is melted and brushed or blown on the parts of the fabric not to be dyed. The lightest color is then applied in a cold bath (a hot bath would melt the masking wax). The fabric is then washed and dried. The wax is removed either by ironing the fabric between blotting papers or by dipping it in gasoline. Repeating this masking and dyeing process as often as is necessary to bring about the desired colors and designs completes the batik.

Fast and Fugitive Dyes

Dye in a cloth that retains its color when the cloth is exposed to conditions of its use is called a *fast* dye. Such conditions include exposure to sunlight, washing, cleaning, exposure to acids and alkalies, and hot pressing. An evening gown that retains its true color under cleaning (a proper condition of use) but which fades if placed in the sunlight (not a proper condition of use) is said to have a fast color. A dye that fades from fabric under proper conditions of use is said to be *fugitive*.

Dyes that are fast for silk or wool probably will prove fugitive when used to color cotton and man-made fibers. The reverse of this will also often prove true. Dyes are specially made to color certain kinds of fiber and for the conditions under which the dyed material is to be used.

The History of Modern Dyes

Dyeing with synthetic organic colors had its start in London in 1856 through an accidental discovery of 18-year-old William H. Perkin. Under Professor A. W. Hofmann, a German chemist, Perkin was trying to make synthetic quinine. He added oxygen to aniline oil (a derivative of benzene), expecting the mixture to yield white crystals. Instead, a black, tarry mass resulted. To clean his flask, Perkin soaked this mass in alcohol, which then turned purple. He dipped a strip of silk into the mixture and it came out dyed a rich, rather reddish purple.

Perkin called his dye *mauve* (a French word for a purple color yielded by the mallow plant). Financed by his father and advised by Von Hofmann, Perkin went into the dye business. (Because Perkin's first synthetic dye was made from aniline oil, synthetic dyes were for long called "aniline dyes," although many dyes were made from other coal-tar products.)

German dyemakers proved most interested in synthetic dyes. They originated many to replace the vegetable, animal, and mineral dyes. Because the new colors proved less troublesome, dyed more quickly, were cheaper, and were more fast, they were sold all over the world. By the beginning of the 1900's, the importation of indigo, madder, and other raw materials for dyes almost ceased. The German dyemakers held world leadership in dyemaking until after the start of the first World War. A blockade of Germany cut off other countries' dye supplies. They began to make their own dyes. Today the United States is one of the principal dyemaking countries.

Dynamite and Nitroglycerin. Nitroglycerin, the most powerful explosive in common use, was discovered in 1846 by the Italian scientist Ascanio Sobrero. It is made by treating glycerin with a mixture of concentrated nitric and sulfuric acids. Although used as a headache remedy, under the name "glonoin," it proved too difficult and dangerous for practical blasting purposes until Alfred Nobel of Sweden began his experiments in 1862. Nobel's brother was blown to pieces during the tests, and Nobel was forced to move his laboratory to a barge anchored out in the middle of a lake. Then a ship loaded with nitroglycerin blew up off Colón, Panama, and most of the nations of the world forbade their vessels to carry it. Nobel, however, refused to abandon his labors, and in 1866 he was rewarded by the invention of dynamite. This is today the commonest and safest of the high explosives, for the first time enabling man to blast away great masses of rock and other obstacles with comparative safety.

Dynamite consists of a mixture of the liquid nitroglycerin with some absorbent substance, or "dope," giving it a solid form. The absorbent used by Nobel was kieselguhr, or diatomite, a kind of earth formed by countless millions of tiny fossil plants known as "diatoms." Later wood pulp, sawdust, charcoal, plaster of Paris, and many other substances came to be used. Perhaps the most powerful form of dynamite is the "blasting gelatin" devised by Nobel in 1875. This contains nitrocotton colloidally dissolved in nitroglycerin and is waterproof. Many dynamites use ammonium nitrate mixed with nitroglycerin.

Ordinary dynamite is usually made in the form of "sticks" from one to two inches in diameter and about eight inches long. These consist of brown paper wrappers coated with paraffin to keep out moisture. If a small quantity of dynamite is set on fire, free from pressure, jar, or vibration of any kind, it will burn; but if the least blow strikes it while burning, such as the fall of a tiny pebble, it will explode with great violence. Dynamite is usually set off with a detonator or blasting cap. (*See also* Explosives; Glycerin.)

Dynamo. A machine for transforming mechanical power to electrical power is called a dynamo, from the Greek word *dynamis*, meaning "power." In its most simple form a dynamo is merely a loop of wire rotating between the poles of a magnet and cutting the magnetic lines of force. The modern name for dynamo is electric generator. (*See also* Electric Generator and Motor.)

EAGLE Majestic appearance and power of flight have won for the eagle the title "king of birds" From the most ancient times it has been a symbol of might and courage Five thousand years ago the Sumerians of the Euphrates Valley chose the "spread eagle" as the emblem of their power So did imperial Rome many centuries later From Charlemagne it descended to Prussia and other German kingdoms and later Napoleon I adopted it The double-headed eagle of ancient Assyria was used by the Byzantine Empire and reappeared on the imperial coats of arms of Russia and Austria

The American bald eagle was chosen by Congress in 1782 as the emblem of the United States On the national seal the bird stands with wings outstretched, holding a spray of olives in one claw and arrows in the other On coins, military insignia, and many other devices, the eagle appears in a variety of postures—at rest or in flight, in side view or front view

The Life Story of the Bald Eagle

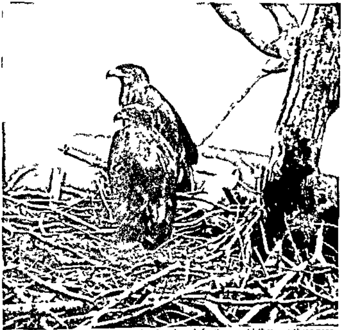
Only two species of eagle are found in the United States and Canada—the bald eagle and the golden eagle The bald eagle is the more common It is strictly an American bird, unknown in the Old World

The adult birds are dark brown, except for white tail feathers and white plumes on the head and neck The early colonists, accustomed to the gray sea eagle of Europe, called these newly encountered birds "bald headed" ("Bald" originally meant "white," as in "bald faced" horse) The female, fiercer than the male and several inches larger, measures about three feet in length and has a wing spread of more than seven feet The male has a high clear call, *cac, cac, cac* The female's cry is harsh with a screaming note, like a loud laugh

The bald eagle is a sea eagle and never wanders far from rivers, lakes or seashore It feeds on dead fish or other carrion, supplementing this diet when it can with fresh fish and small game—ducks, rabbits squirrels, mice, and snakes Soaring high overhead, it scans the shore and water When its remarkably keen eyes detect a fish swimming near the surface, it plunges down and tries to seize it But the eagle is not a very good fisherman It much prefers to hold up the osprey, or fish hawk, and rob the other bird of its catch When it spies an osprey rising with a fish in its talons, the eagle swoops down and gets between the osprey and the water Then it drives its victim up higher and higher until the smaller bird becomes frightened and exhausted, and drops the fish The eagle catches it in mid-air

The bald eagle migrates only if the water freezes over, and it returns each year to the same nest (called an aerie) with the same mate Built on cliff or tree top where it will command a wide view, the nest is made of dead branches and lined with grass and leaves Each spring new sticks and lining are added so that the nest increases in size from three feet to as much as eight feet in width and depth Two or three white eggs are laid Male and female share the work of feeding their ravenous young When hatched the eaglets are clothed in white down After a few weeks they put on dark brown plumage Not until they mature—at the age of three years—do they add the white trimmings of the adult birds During the earlier period they are often mistaken for golden eagles

YOUNG BALD EAGLES ON THEIR NEST



Bald eagles do not get their white head and neck feathers until they are three years old These eaglets are still in the nest, but they are nearly as big as their parents

The Golden Eagle—Noblest of the Tribe

The golden eagle, a magnificent mountain-loving bird, is more common in the Old World than in the New It is found in the western part of North America from Mexico to Alaska, and is sometimes seen in the

East as a migrant. It is somewhat larger than the bald eagle, and its brown plumage is darker, except for tawny feathers on its head and neck that shimmer like gold. The bald eagle has bare "ankles," whereas the legs of the golden eagle are feathered to the toes.

The golden eagle builds its huge nest on a high mountain crag. It is a mighty hunter and seldom stoops to carrion. Jack rabbits, ground squirrels, grouse, and rattlesnakes are its usual food, but it sometimes preys on the young of domestic animals. It can carry up to six pounds in its talons. For this reason, the often-repeated story that eagles carry children away is absurd. Neither the bald nor the golden eagle could carry such a load.

Eagles are birds of prey, related to vultures, hawks, and falcons. Scientific name of bald eagle, *Haliaeetus leucocephalus;* of golden eagle, *Aquila chrysaëtos.* The common eagle of Europe is the gray sea eagle, *Haliaeetus albicilla.*

The Story of Old Abe —the War Eagle

THE MOST wonderful eagle in American history is not the one pictured on coins and stamps. This wonderful eagle was a real, live, flesh-and-feathers eagle. His name was Old Abe.

He was hatched in a treetop nest in northern Wisconsin many years ago. When he was only a very little eaglet, an Indian named Blue Sky saw the nest and chopped the tree down. The eaglet fell from the nest and Blue Sky caught him and took him home in his canoe. There the Indian fed him on fish and meat and the eagle soon became tame. Then Blue Sky sold him to a white man for five bushels of corn. The Civil War began about that time and the Eighth Wisconsin Volunteers thought it would be fine to take a real live "bird of freedom" to the war; so they bought the eagle for $2.50.

At first the eagle walked around the camp like a puppy, and like a puppy he chose a master. He took a great fancy to a soldier named Jimmie McGinnis and would not allow anyone else to feed him.

Jimmie made a red-white-and-blue shield for the eagle's perch. He set this on a pole and tied the eagle by the foot, leaving the cord long enough so that the bird could fly a little way. When the regiment went on the march Jimmie carried the eagle beside the color bearer. The eagle was cheered by crowds of people in every town. In the state capital he was named "Old Abe" for President Lincoln.

By that time Old Abe had grown to be a big bird. Golden lights gleamed like copper in his rich brown coat of feathers. His head and tail were white, his legs bright yellow, and his claws a shining black. Although he weighed only 10½ pounds, when he was angry or excited he ruffled his feathers until he looked twice as big. When his wings were spread they measured 6½ feet from tip to tip.

Old Abe never liked boys or dogs, because they teased him. But he loved marching soldiers and cheering and music. When the band played he flapped his wings and made a whistling sound. He liked to sit on an officer's horse to watch a parade. The officers of the regiment always saluted him.

A battle excited Old Abe. The first time he heard a cannon shot, he broke his cord and soared away. The soldiers thought he was gone forever. The smoke hid him, but amid the booming of the big guns they could hear him screaming. After the battle was over he circled the sky and then dropped to his perch. Whistling and chuckling and ruffling his feathers, he walked and fluttered all around the camp.

After that Old Abe was not tied. He often left his perch to go fishing or hunting. He would lean over and chuckle a sort of good-bye to Jimmie. Then he would soar aloft and fly past the marching regiment. The boys always cheered him when he came home.

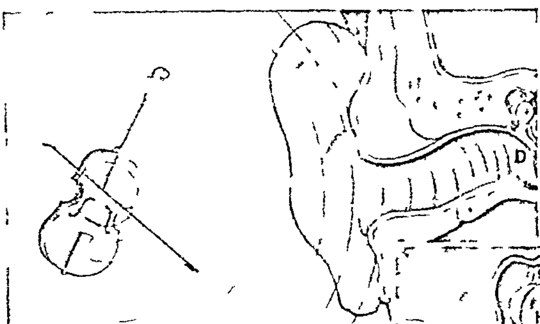
He went through four years of the war. He was in 22 battles, and after every one of them he returned to his own regiment. His perch was often hit by bullets and several times his feathers were torn, but he was never badly hurt.

After the war Old Abe was given to the state of Wisconsin. For 15 years he lived in the State House in Madison. In 1876 Jimmie McGinnis took him to the Centennial Exposition in Philadelphia, and there he told the famous eagle's story to thousands of admiring visitors. Jimmie remained his keeper until the bird died of old age in 1881. Then the skin was stuffed and Old Abe was set up on his old perch, looking as though he might spring up at any moment and soar far up in the sky, as in the long past days of the Civil War. He was one of the sights in Madison until the State House was burned.

THE AMERICAN BALD EAGLE SYMBOL OF FREEDOM

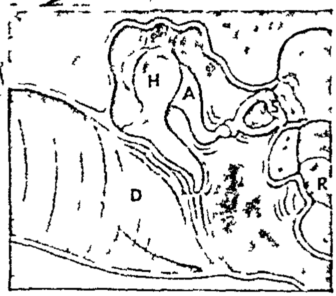
The only one of the eagles distinctly American is the bald eagle distinguished by its gleaming white head and white tail The bird above is Jerry inmate of the National Zoölogical Garden in Washington D C Since 1940 bald eagles have been protected by law against killing or capture Eagles mate for life and return year after year to the same nest The female incubates the eggs for about 35 days while the male feeds and guards her The two or three eaglets remain in the nest for nine or ten weeks

HOW *the* EARS *Carry* MESSAGES *to the* BRAIN



Imagine a violin being played and sending out sound vibrations in all directions. Some strike a listening ear (above), enter the ear canal, and strike the drumskin (D).

EAR. The chief business of the ear is to collect sound vibrations from the air and transform them into messages which pass along the auditory nerve to the brain. The pictures on this page illustrate how the human ear does so. The picture on the next page shows the parts of the ear in relation to one another. The pictures also show that the ear has three divisions, an outer, a middle, and an inner ear.



In the middle ear, shown here enlarged, a chain of bones, hammer (*H*), anvil (*A*), and stirrup (*S*), strengthens the vibrations as it carries them to an oval window in the inner ear.

The outer ear collects and transmits sound waves, or vibrations. The collecting part (the *auricle*) is the thin, skin-covered cartilage we usually mean when we speak of "the ear." It is more efficient in animals than in man. It is relatively larger and catches larger segments of sound waves. Animals can move it freely. Watch a dog or cat "prick up his ears" when he hears a sound. He turns them this way and that, separately and together, to locate its source. A human being turns his head to turn his ears.

The outer ear continues into the head as a tubelike passage, the *external auditory canal.* The auricle funnels sound waves through this passage to the middle ear. The canal is about an inch long It forms an S curve as it goes in. It narrows at the middle and again near the inner end. Hairs and wax line the canal. These obstacles help to prevent dirt particles or insects from getting inside.

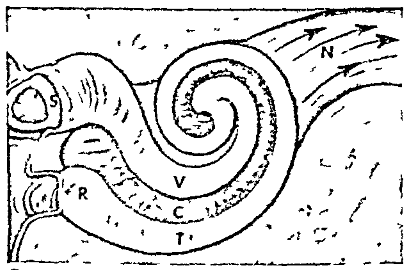
A moderately taut membrane closes the inner end of the external canal. We usually call this the "eardrum." It is really the *drumskin*, or *tympanic membrane.* It is paper thin and can respond to very weak air vibrations and start them on their way across the middle ear.

The middle ear transmits and intensifies sound vibrations. It is an air-filled cavity (the *tympanic cavity*) bridged by three little bones. These are the hammer, anvil, and stirrup, so named because of their shape. The hammer, attached to the drumskin, vibrates with it and works with the anvil as a bent lever to vibrate the stirrup. These bones, held in place by minute ligaments, are so tiny they can pass along the slightest movement of the drumskin.

The stirrup fits into and closes an oval window in the inner ear. The window is about 1/28 the area of the drumskin. Because of this size relation the sound waves gain energy as they enter the inner ear. This is important, because in the inner ear vibrations have to travel through fluid, and this is denser than air.

The hearing part of the inner ear (*cochlea*) transforms vibrations into nerve impulses. To understand how it works we must know something about its anatomy.

The inner ear is made up of communicating sacs and ducts contained in cavities hollowed out of the temporal bone. The sacs and ducts form a *membranous labyrinth.* The cavities in bone form a *bony labyrinth* The membranous labyrinth does not fill the bony labyrinth. Outer fluid (*perilymph*) occupies the extra space The ducts contain inner fluid (*endolymph*). The labyrinths have two main divisions One is the vestibule This is the organ of balance and will be considered later The other is the cochlea



Sound waves go through fluid in spiral "stairways" (*V* and *T*) of the cochlea, and a round window (*R*) bulges. Nerve stimuli are generated in the cochlear duct (*C*). The auditory nerve (*N*) carries the message to the brain.

The bony cochlea is a snail-shaped channel in bone A tubular membrane called the cochlear duct follows its spiral outer edge from top to bottom. This divides the cochlea lengthwise into upper and lower "stairways" (*scalae*). Look at the third picture on this page to see the arrangement. The upper scala, labeled "V," begins in the vestibule and is called the vestibular scala. The lower scala, labeled "T" begins at a round window (*R* in the picture) facing the tympanic cavity and is called the tympanic scala. The round window is closed by an elastic membrane which yields to the pressure of the fluid vibrations in the cochlea

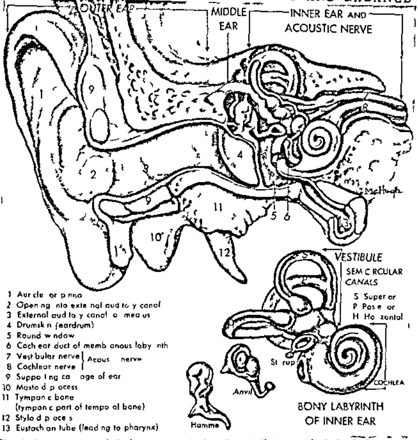
When the message of the nerve reaches the brain, sound is heard. Hearing centers enable us to recognize familiar sounds and to identify new ones.

The cochlear duct (*C*) contains the ear's sound analyzer, a basilar membrane supporting the organ of Corti. This is spiral, like the duct. The membran

is made up of about 24 000 crosswise elas tic fibers The organ of Corti, named for the man who first identified it consists of a framework supporting about 15 500 hair cells Each cell has 40 to 100 hairs Fibers from the au ditory, or acoustic nerve are in contact with these cells

No one knows ex actly how this sound analyzing mechanism works According to one theory the fibers of the basilar mem brane are progressively tuned — the short ones to high frequencies the long ones to low frequen cies A musical chord excites several groups of fibers at the same time A loud sound gives a fuller vibra tion to the fibers than a faint sound Whatever the pitch or loudness the vi bration of the basilar fibers is transmitted to their associated hair cells These gen erate impulses in associated nerve fibers, which carry them to the brain

THE HUMAN EAR—ORGAN OF HEARING AND BALANCE



Here is the human ear with the bone cut away to show the parts that are ins de the head The insets show the little bones of the middle ear hammer anv l and stirrup) and the inner ear greatly enlarged

One important part of the hearing apparatus has not been mentioned yet This is the Eustachian tube For the drumskin to vibrate properly the air pressure must be the same on both sides It is equalized by the Eustachian tube This passage from the pharynx keeps the middle ear cavity filled with air to match the outside air pressure on the drumskin Usually the tube is closed, but it opens when we swallow or yawn

Differences in pressure on the two sides of the eardrum cause a ringing and a sense of fullness in the ears This may take place aboard an airplane or in a fast elevator, when the change of altitude alters the out side air pressure very rapidly But the unpleasant feeling in the ears is relieved by swallowing

Violent air waves from a near by explosion may burst the drumskin if the Eustachian tube is closed Artillerymen are taught to keep their mouths opened wide when big guns are fired

The Organ That Helps Us Keep Our Balance

Besides making it possible for us to hear the ear helps us to keep our balance The organ of equilibrium is the vestibular part of the inner ear Housed in bone it consists of three looped ducts called the semi circular canals and two connecting sacs the *utriculus* and the *sacculus*

A sensitive spot inside the utriculus and another in the sacculus support hair cells These stick up into a kind of jelly weighted with mineral dust called ear dust (*otoconia*) As we lean over or tilt the head in any direction the pull or pressure of this dust on the hairs generates nerve impulses These are picked up by the vestibular part of the acoustic nerve and travel to the brain The brain interprets them automatically, so that we know the direction of motion

The semicircular canals act without the aid of ear dust Each canal has a flasklike widened end A sen sitive ridge inside this supports hair cells When the head moves endolymph streams over the hairs Nerve impulses governed by the speed and direction of the flow of endolymph are generated The brain receives and interprets these impulses with those from the utriculus and the sacculus (*See also* Deaf Educa tion of)

The WONDERS *of Our* HOME—*the* EARTH

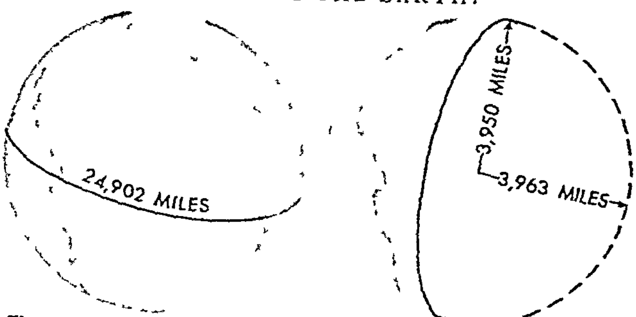
What is the earth? It is a huge sphere, made mostly of rock. It spins endlessly on its axis, night following day. As it spins it also rushes through space, going about 18 miles a second on its yearly journey around the sun. Seen from outer space, the earth's surface would probably be obscured by greenish-blue atmosphere.

EARTH. The earth is man's home. It provides the food he eats, the clothes he wears, and the house he lives in. All these came in one way or another from the earth. Even man's body is made of substances that came originally from the earth or its atmosphere.

Wherever we look, the part of the earth we see seems flat, except where it is wrinkled into mountains. But scientists know that it is a huge ball, spinning and rushing along through empty space. The picture at the top of the page suggests this motion. The pictures at the bottom tell the size of the earth and the tremendous amount of matter in it.

To get some idea of its size, imagine a motorist driving around the earth. If he could find such a road and if he drove 300 miles every day, he would need nearly three months for the trip. But the figure for the amount of matter in the earth is far too great to be explained in any such way. We can visualize a heap containing a hundred tons of coal or a thousand tons. But nobody can imagine a mass as big as the number given at the bottom of this page.

HOW BIG IS THE EARTH?



The earth measures about 25,000 miles around and about 8,000 miles through. The picture above gives the exact size of these measurements.

What Is Inside the Earth

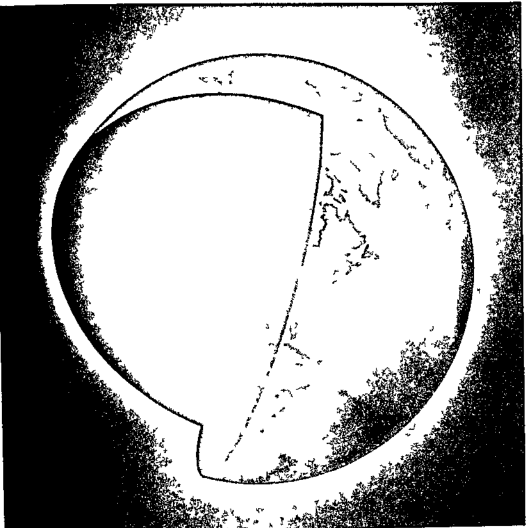
The earth is made almost entirely of rock and metal. If some super giant could cut into it so that the inside could be seen, it might look as shown on the opposite page.

Around the outside the earth has a thin covering of soil varying from a few inches to many feet in thickness. Bodies of water lie in depressions, forming lakes and oceans. Inside this covering, the rock is solid to a depth of 30 to 50 miles. This layer of solid rock, together with the surface soil and water, makes up what geologists call the earth's *crust*.

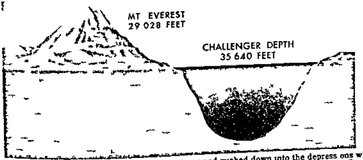
HOW HEAVY IS THE EARTH?

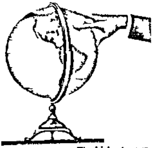
6,570,000,000,000,000,000,000 TONS!

This enormous figure would be the weight of the earth if it could be weighed on a scale. But nobody can do this, so scientists always speak of the earth's *mass*, meaning the amount of matter in the earth. The figure is read as 6 sextillion, 570 quintillion tons.



The interior of the earth may look somewhat as it's shown above. The center is white-hot. Geologists believe that it consists largely of nickel and iron. Most of the rest is hot molten rock, except for the cool solid crust on the surface. Around the earth is the atmosphere. Even though most of the earth is molten, the force of gravity keeps it as rigid as a ball of steel.





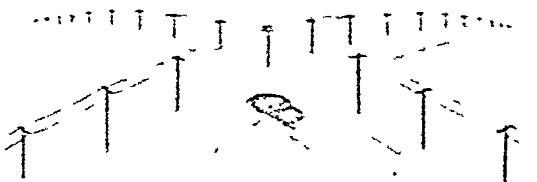
The earth's surface is wrinkled up into mountains and pushed down into the depressions which hold the oceans. The highest mountains rise about as far above sea level as the depressions dip below—five and one-half to almost seven miles. The earth, however, is so big that these elevations and depressions on its surface amount to little. It is comparatively as smooth as a schoolroom globe.

ONE PROOF THAT THE EARTH IS ROUND

Below the surface, the earth's temperature increases one degree Fahrenheit for every 60 to 65 feet of depth. Scientists think that rock below the crust is hot enough to melt It does not do so because the crust bears down with a weight of 150,000 pounds to the square inch and holds it rigid

This layer of hot, compressed rock is called the *outer mantle*, or the *dense rock shell* It is about 600 miles thick Below the mantle lies an intermediate layer, about 1,200 miles thick Scientists have learned something about it by tracing the travel of earthquake shocks The layer reacts as though it were made of steel. Probably it consists of compounds of iron and other metals, mixed with stony material

The central part of the earth is called the *core*. It lies under tremendous pressure of about 45 million pounds a square inch Scientists believe that it is made of iron and nickel. One reason for their belief is that many of the meteorites that strike the earth from outer space are made of these metals. They think that the earth itself must be made of much the same materials as these other smaller members of the solar system. Scientists know also that the interior of the earth is much heavier than are its top layers



As a ship sails away, the hull drops below the horizon before the upper works disappear So the surface of the sea (and therefore of the earth must be curved The same thing happens whatever direction the ship takes This proves that the earth is a sphere. As one drives in an automobile across flat country, tall structures behind him drop out of sight just as the ship does.

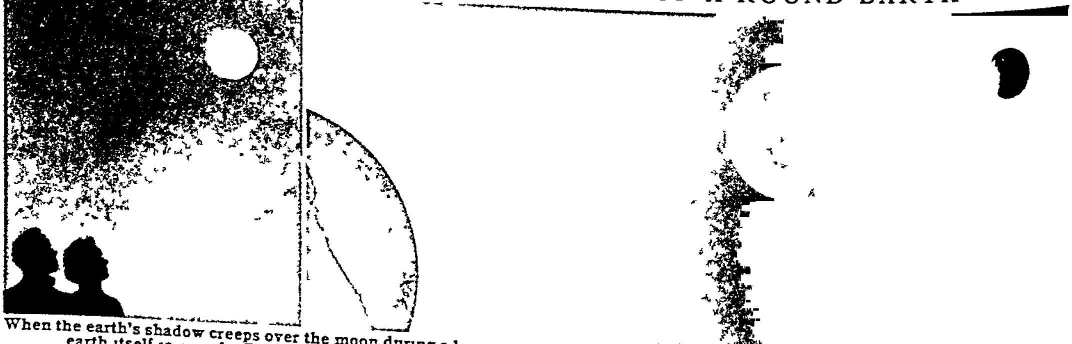
Why We Know the Earth Is Round

People often call the earth a "globe." This is correct; the earth *is* almost perfectly round. But its roundness is not obvious to our eyes. In all level country and over oceans and large lakes, the surface seems flat But there are many proofs that the earth is actually a ball. Two of the simplest are shown in pictures on this page.

In ancient times, the Greeks in seacoast cities noticed how a ship disappears below the horizon If this happened only when the ship sailed straight away from the shore, it could be explained by saying the earth was a cylinder. But the same thing happens whatever the ship's direction may be. Therefore the earth must be a sphere.

Another proof is furnished by the shape of the earth's shadow when it causes an eclipse of the moon. Travelers can find a third proof in the shifting movement of the stars. If a traveler goes south, the stars wheel overhead from east to west every night. But the tracks they follow shift northward. If the traveler goes north, the tracks shift in the opposite direction.

AN ECLIPSE SHOWS THE SHADOW OF A ROUND EARTH



When the earth's shadow creeps over the moon during a lunar eclipse, the shadow's edge is plainly round. This fact suggests that the earth itself is round. The picture at the right shows how the earth casts its shadow on the moon during an eclipse.

These shifts indicate that the traveler is on a round earth.

Movements of the Earth

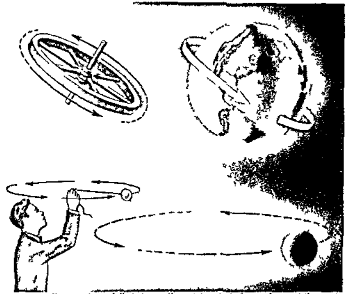
Until a few hundred years ago, men thought the earth stood still in the middle of the universe, and that the sun, moon, and stars went around it. Today we know that the earth is moving constantly in two ways. We cannot feel the movement because we go along with the surface as it moves and so does the air.

Most of the earth's many motions are small. Only two are important in our daily lives. The earth *rotates* on its axis once a day and *revolves* around the sun once during every year.

Day and Night

Rotation is important because it causes day and night. If the earth stood still, one side would always face toward the sun in daylight. The other side would face away from the sun, in darkness. Rotation carries every point on the earth around the light side, then the dark side, every 24 hours. Notice that the word "day" can mean the daylight hours or it can mean the time taken for one complete rotation through daylight and darkness. (*See also* Day; Time.)

ROTATION AND REVOLUTION OF THE EARTH



Astronomers distinguish carefully between the *rotation* and the *revolution* of the earth. Rotation means the spinning of the earth on its axis, like the motion of a turning wheel. Revolution refers to the earth's yearly movement around the sun. This motion is like that of a stone being whirled around on the end of a string. The earth's rotation causes day and night and its revolution marks off the year.

The Year and the Seasons

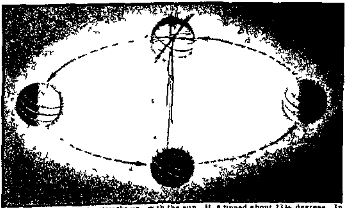
For convenience in timekeeping men long ago divided the complete day into 24 hours. Two units of time, the day and the hour, are the most important in day-to-day living. For measuring long periods of time the *year* is a more useful unit. This is the time taken for another motion of the earth—its revolution around the sun.

The year is important because it marks the change of seasons from winter to summer and back again. This change governs the food producing work of farmers, the supply of game for hunting peoples, and many other aspects of life. *The year* is the measure which we use for length of life and for the march of events in history.

The accompanying picture shows that a year can be measured from the time the earth stands in some position relative to the sun and *stars until it stands in exactly the* same position again. The time taken for one complete revolution of the earth around the sun is about $365\frac{1}{4}$ *days*. The quarter day complicates calendars and makes leap years necessary. (For further information about the year, *see* Astronomy, Calendar; Year.)

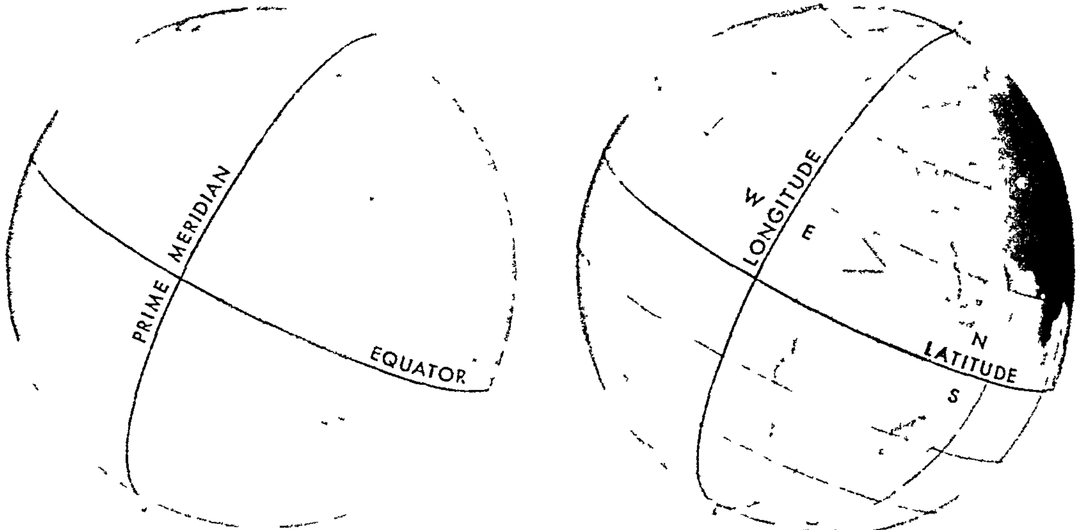
The change of seasons *is caused by the slant of the* earth's axis, as shown in the picture. The slant can be seen on many small globes. They are mounted with the North and South Poles set on a slant or tilt of $23\frac{1}{2}$ *degrees from the vertical. The earth itself is on the* same slant as it spins on its axis and revolves around the sun. If the earth and the sun both stood at

THE EARTH'S SLANTING AXIS CAUSES THE SEASONS



The earth's axis is not "straight up" with the sun. It is tipped about $23\frac{1}{2}$ degrees. In June (left) this tilt gives the Northern Hemisphere more direct rays of the sun. In December (right) the Northern Hemisphere receives more slanting rays. In March and September (middle) the rays are between extremes. These variations in the amount of light and heat cause the seasons.

WHAT ARE LATITUDE AND LONGITUDE?



Latitude and longitude start from two imaginary lines, the *equator* and *prime meridian* (left-hand picture). The equator circles the earth halfway between the poles The prime meridian, running from the North to the South Poles, passes through the old Greenwich Observatory in England (Any north-south line running between the poles is called a meridian.) The other picture shows how parallels of latitude and meridians of longitude are laid out from these starting lines.

the same level on a huge floor, the earth's axis would be tilted relative to the floor

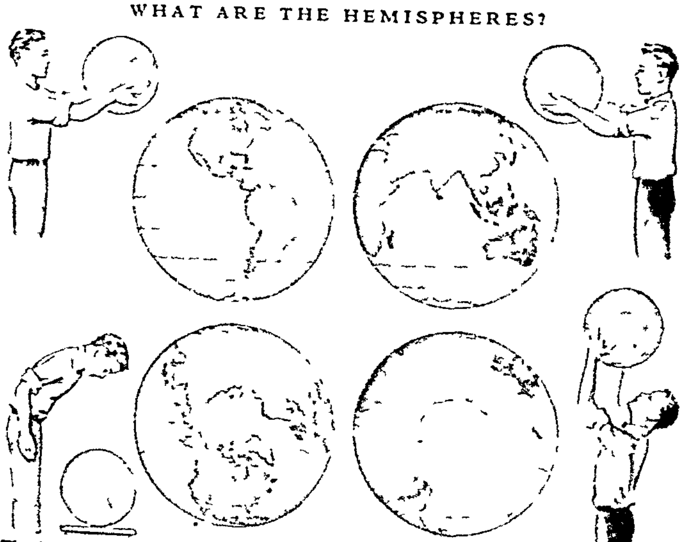
Each pole leans toward the sun half the year and away from the sun the other half So for six months the northern part of the earth receives more direct rays from the sun and therefore more heat During the other months it receives less direct rays and has its cooler season. The South Pole is tipped in the opposite direction. Therefore southern lands have their summer and winter at the opposite times of the year. (*See* Astronomy; Seasons)

Latitude and Longitude

All globes are marked with a pattern of crisscrossing circular lines. These represent imaginary lines of latitude and longitude on the surface of the real earth

Navigators and geographers use latitude and longitude as measures of distance. Latitude is used to measure distances northward and southward from the equator to the two poles. Such measurements are expressed in degrees. (A degree is 1/360th of a circle) Longitude is used in a similar way to measure distances east and west from a *prime meridian* This is an imaginary north-south line running from pole to pole The line passing through Greenwich, England, is most commonly used as the prime meridian (*See also* Latitude and Longitude)

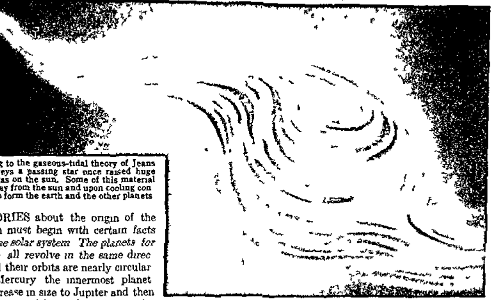
WHAT ARE THE HEMISPHERES?



The four hemispheres are simply four different ways of looking at the earth. Hold a globe even with your eyes so your right hand is over the western bulge of Africa. What you now see is the Western Hemisphere. Look straight down on the North Pole and you see the Northern Hemisphere. Look up at the South Pole and you see the Southern Hemisphere. Eastern Hemisphere Look straight down on the North Pole and you see the Northern Hemisphere. Look up at the South Pole and you see the Southern Hemisphere.

Geography textbooks often speak of *hemispheres* and *zones* of the earth The pictures at the bottom of this page explain what the hemispheres are. The five climatic zones divide the earth more naturally. Around the poles are the Frigid(cold)Zones, where few people live. At the equator is the Torrid (hot) Zone, where few great civilizations have grown up. In between are the Temperate Zones. Here the annual shift of the seasons seems to have its most invigorating effect on human beings. It is interesting that most of the world's great civilizations have arisen in the North Temperate Zone. (*See also* Climate.)

Scientific Theories About the Birth of the Earth



According to the gaseous-tidal theory of Jeans and Jeffreys a passing star once raised huge tides of gas on the sun. Some of this material broke away from the sun and upon cooling condensed to form the earth and the other planets

THEORIES about the origin of the earth must begin with certain facts about the solar system The planets for example all revolve in the same direction and their orbits are nearly circular From Mercury the innermost planet they increase in size to Jupiter and then decrease out to Pluto Their spacing also shows a regular arrangement according to what is known to astronomers as Bode s Law (*see* Asteroids)

In attempting to explain these facts 18th-century theorists proposed the *nebular hypothesis* Immanuel Kant and Pierre Simon Laplace suggested that the solar system condensed from a nebula or whirling cloud of gas and dust Shrinking in successive steps the nebula left rings of matter that condensed into planets The hot gaseous sun in the center of the system was the remainder of the nebula

About a hundred years after this theory had been proposed scientists showed that such rings of matter could not condense into planets by the force of gravity and momentum Accordingly two American scientists T C Chamberlin and F R Moulton proposed their *planetesimal theory* They suggested that at some remote time the sun and an other star passed very close to one another Gravitational force between the two bodies pulled out streams of matter and gave them a whirling motion Later this material condensed into particles and lumps (planetesimals) These collided with one another and eventually clotted together as the planets and their satellites or moons

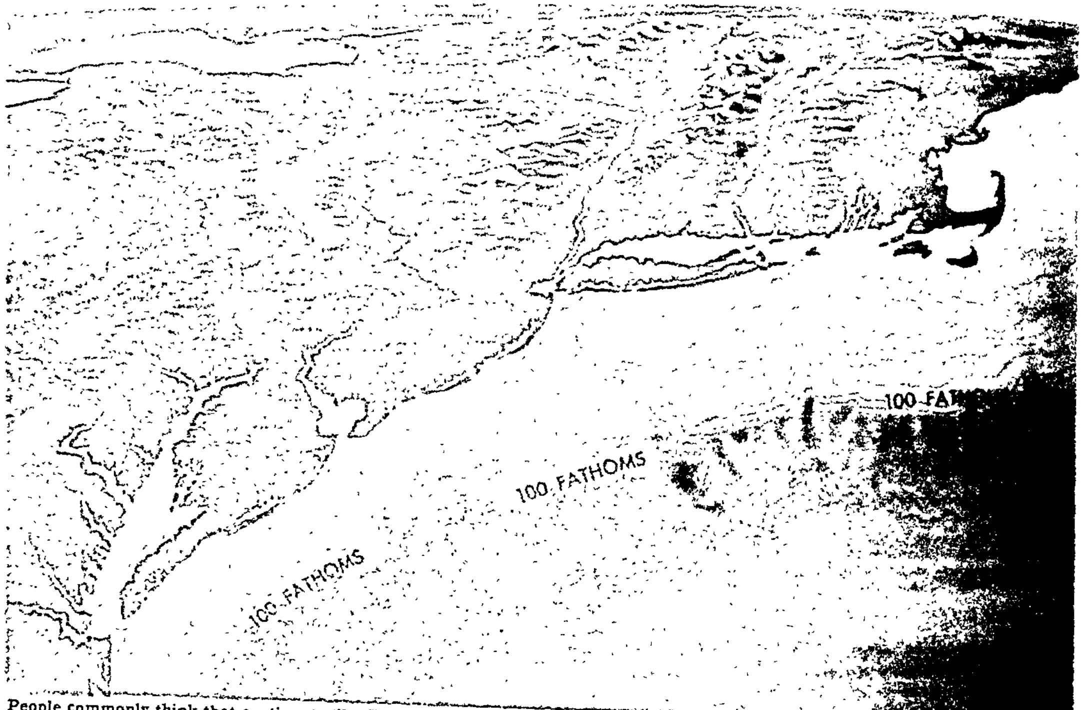
THE FIERY CHILDHOOD OF THE EARTH

Some geologists believe that the earth was very hot while it was taking shape Its surface was a barren waste and volcanoes erupted everywhere through the thin crust of cooling rock. The heat turned all water into steam and clouds of ash filled the air darkening the light of the sun Life could not exist until the earth had cooled

The *gaseous-tidal* theory of the British astronomers Sir James Jeans and Harold Jeffreys was similar They thought however that the original portions of matter had from the beginning nearly the masses of the present planets

Each of these latter theories presented difficulties that could not be explained in terms of mathematics and physics Therefore some scientists have gone back to the old nebular hypothesis as a starting point In 1952 Harold C Urey of the University of Chicago gathered together

CONTINENTS REALLY END BENEATH THE SEA



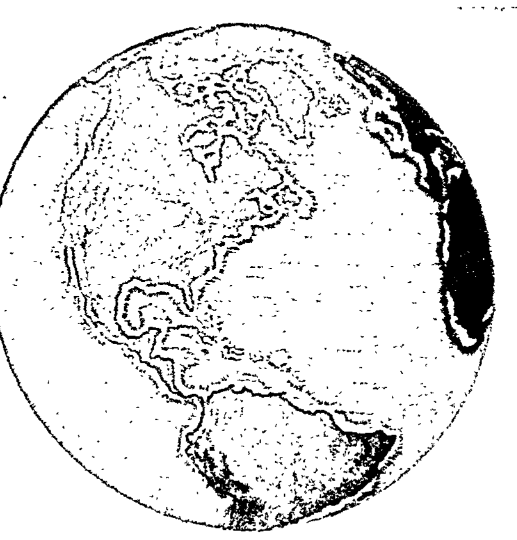
People commonly think that continents like North America end at the ocean shore line. But geologists claim that the true edge lies out at sea, where the water is 100 fathoms (600 feet) deep. The sea bottom out to this line is called the *continental shelf.* The picture shows the surface and cliff like edge of the shelf off New York. The deep gorges off the mouths of great rivers and other features have been discovered by careful deep-sea soundings.

a great deal of evidence in support of a *dust cloud hypothesis*. According to this theory whirling dust in space was pushed together by the pressure of starlight, much as the tail of a comet is affected by sunlight (*see* Comet). The dust compacted to form the sun and a surrounding disk of dust. Turbulence in the rotating disk caused eddies to form and these whirlpools in turn condensed into the planets and their satellites.

Age of the Earth

Many attempts have been made to determine the age of the earth. (*See* later section in this article; Geology.) Most modern calculations give an age of more than two billion years.

Scientists have also tried to explain why the earth's continents, islands, and oceans are located where they are. But as yet no theory explains all the known facts. The continents are most puzzling in view of the fact that they do not end at the water's edge, as shown on maps.



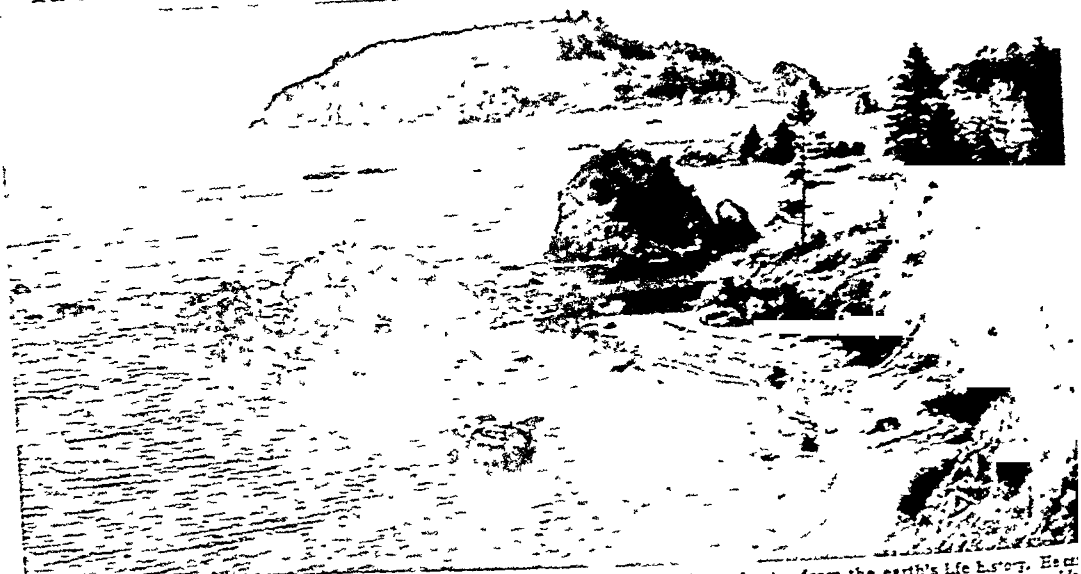
The lighter tinted part of the ocean around North America shows how far the continental shelf extends beyond the shore line.

The true edge lies offshore under the sea. The underwater portion from the shore line to the edge is called the *continental shelf*. It slants gently away from the shore to depths of about 100 fathoms (600 feet). Then the bottom drops down sharply thousands of feet to the ocean deeps.

The continental shelves have low valleys and hills. But at the outer edges of the shelves, the valleys are so deep and their sides so steep that they are called canyons. One underwater canyon southeast of New York City is as much as 4,000 feet deep. It connects with the valley of the Hudson River.

This remarkable picture of a port on of the earth s surface was taken at an altitude of about 100 miles by a camera attached to a V 2 rocket. It shows the earth s curvature and mo e than 200 000 square miles of the United States and Mexico The da k body of water at the upper left s the Gulf of Ca forn a The wh te fluffs you see floating above the surface are cloud format ons. The picture was taken from above the Wh e Sands N M eg on where the ocket was launched

How Earth Science Explains Land and Sea



In a beautiful shore scene such as this, an observing person can read an absorbing chapter from the earth's life history. He can see features that tell him how the coast was raised and then crumbled by the waves on the land. He can see how the material in life-giving soil was formed. In short, he can see how the landscape came to have its present character.

THE SURFACE of the earth presents an almost endless variety of features. When we travel over it we see lands, rivers, lakes, and oceans. We find regions that are hot or cold, wet or dry, level or covered with mountains. We pass swamps and ride through broad valleys. Other valleys are narrow and very deep.

These different features of the earth did not just happen nor have they always been here. They were made by great forces which work ceaselessly shaping the surface. If we understand these forces, we know why the earth's surface looks as it does.

Schools include study of these forces and their effects as part of *earth science*. Scientists call the subject *geomorphology* (from Greek *geo-* for "earth" and *morphe* for "form"). Older names for the science are *physiography* and *physical geography*.

Changes on the Earth

The earth itself is constantly changing its surface, heaving up some parts as high mountains and letting other parts sink, even beneath the ocean. The gigantic forces which cause these vast changes are explained in the article on Geology. They are responsible for the largest and most obvious features of landscape and seascape.

But human beings live close to the earth's surface. For them, perhaps, the details of the surface are more important than its grander aspects. In shaping these details, no force plays a bigger part than water action. Water is constantly at work, wearing down high land and seashores, and building up low land and the sea bottom with gravel, sand, and mud. Earth science can be most easily understood by studying water and water action first.

LAND AND WATER AREAS

Nearly three-fourths of the earth's surface is covered by water. The following areas are in square miles:

Land	55,468,400
Water	140,481,900
Total	196,950,300

Waters of the Earth

THE SUPPLY of water for land animals may seem to come from lakes, streams, wells, or other sources on the land. But these sources get their water from rain or snow. In the end this water comes from the oceans. So the oceans are the ultimate source of water supply.

Water covers almost three-fourths of the earth. The word *ocean* is used for the largest bodies of water. The biggest of these, the Pacific, covers one-third of the earth. The smallest, the Arctic, covers nearly 3 per cent of its total surface.

Smaller bodies of water are called *seas*. A sea almost surrounded by land may be called a *gulf*. The areas of the principal oceans, seas, and gulfs, may be found in a table with the entry *Ocean* in the FACT-INDEX.

As everyone knows, the water of the oceans and seas is salty. Through the ages, salt has been dissolving in water on the land, and rivers have carried it to the oceans. The amount of salt in river water is too slight for anyone to notice. But once the salt reaches the ocean it stays there; and the accumulation during millions of years has given ocean water its salty character. (*See also* Ocean.)

Man, land animals, and most land plants cannot use salty water. Therefore the vast supply in the oceans would be useless to them if it were not for rain and snow. But every instant, day and night, a vast

amount of ocean water evaporates into the air leaving its salt behind Then the water is *fresh* and usable by land creatures The great winds of the earth carry it over the land and drop it as rain or snow (*see* Climate Weather Winds)

Part of the rain water and melted snow runs into streams and fills ponds lakes and marshes Part soaks into the ground There it remains for months or years until it comes to the surface in springs or is pumped from wells This water is often called *ground water*

Sooner or later the ground water comes to the surface through springs or in other ways (*see* Spring) Some of it drains from underground strata into rivers or lakes The Great Lakes of North America receive most of their water in this way Plants also bring enormous quantities to the surface

Once the water emerges it drains off through streams and rivers to the oceans and is available to be evaporated again This constant circulation between ocean and land is called the *hydrologic cycle* or *water cycle* (*see* Water)

Water on the Land

Water is important for its effects upon the land as well as for supporting life The most striking effect is a constant wearing away (*erosion*) of material from higher parts of the land

Rain and melted snow often carry away a thin film of material when they flow off a surface This is called *sheet* erosion Deeper and more visible wearing occurs when water gathers in streams and rivers There it has a current and cuts into the ground This is called *stream* erosion

At the same time water deposits the worn material in lower parts of the land or even carries it to the sea There the deposited material gradually builds up the sea bottom near the shores These processes of wearing down and building up are sometimes called *degradation* and *aggradation*

Streams Ponds Lakes

The water of streams flows downhill through channels that the streams cut into the land Some channels fill the bottoms of valleys that are narrow and have steep sides Most valleys however are wider than the channels of their streams Certain rivers flow through broad flat valleys that are dry most of the time In spring melting snow swells the volume of these rivers Then they overflow their banks and flood the surrounding bottom lands

RAIN ATTACKS THE YIELDING EARTH

Water is one of the most powerful of the earth shaping forces Rain constantly erodes exposed banks like this one Year after year it eats away the earth and deposits it elsewhere Thus high places are flattened and low places built up

Stream water often gathers into broad quiet expanses called *ponds* and *lakes* Ponds cover only a few acres but some lakes cover thousands of square miles A few lakes are formed at wide parts in rivers Others lie in shallow basins and some fill craters in extinct volcanoes Many lakes have formed in valleys where an ancient glacier melted and left a dam of ground up rock

Most lakes are filled with fresh water but some lakes lie close to the ocean and the tides carry salt water upstream to them Such lakes are called *brackish* Salt lakes also are found in valleys among mountains where water can flow in but cannot flow out again Thus the lake accumulates salt just as the oceans do from the tiny amounts brought by streams Some of the lakes have become more salty than the ocean (*see* Great Salt Lake Caspian Sea)

How Erosion Changes the Land

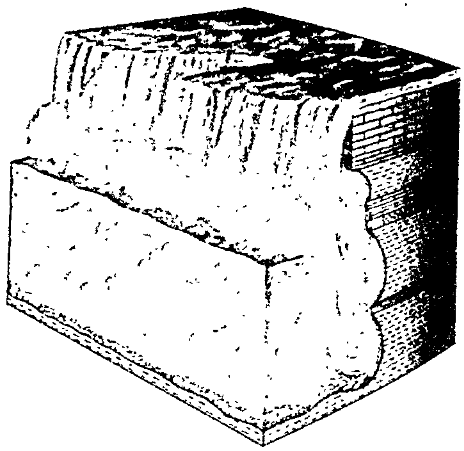
WHEN rainfall is plentiful erosion goes on until it turns the surface of the region into hills and ridges It may even form mountains if the land is very high by cutting away soft material and leaving hard rock standing in high masses At first the hills and mountains are steep At the top their *sides come together in points or sharp ridges that* look like the peak of a roof But erosion gradually blunts and rounds these sharp tops and wears the side slopes down until they are smooth

A complete river system in such a region resembles a tree in form The main river forms the trunk with its roots downstream at the river mouth Streams that flow into the river are branches Smaller creeks or brooks form the branchlets and twigs The smallest ones flow only when snow melts or after hard rains This pattern is called *dendritic* from the Greek word *dendros* for tree

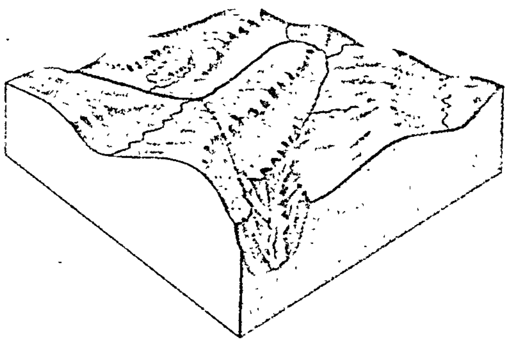
How Rivers Build Land

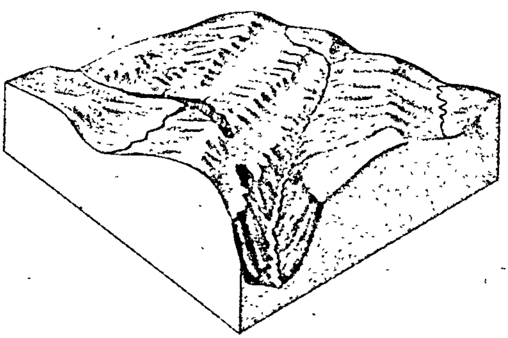
As rivers erode the land they wash stones sand and mud downstream In flood times they get more eroded material than they can carry later when the rush of current slackens When this happens the streams drop their loads in their channels or on the flat bottoms of valleys Valleys which receive flood deposits are called *flood plains* Many flood plains have thick layers of soil deposited by rivers

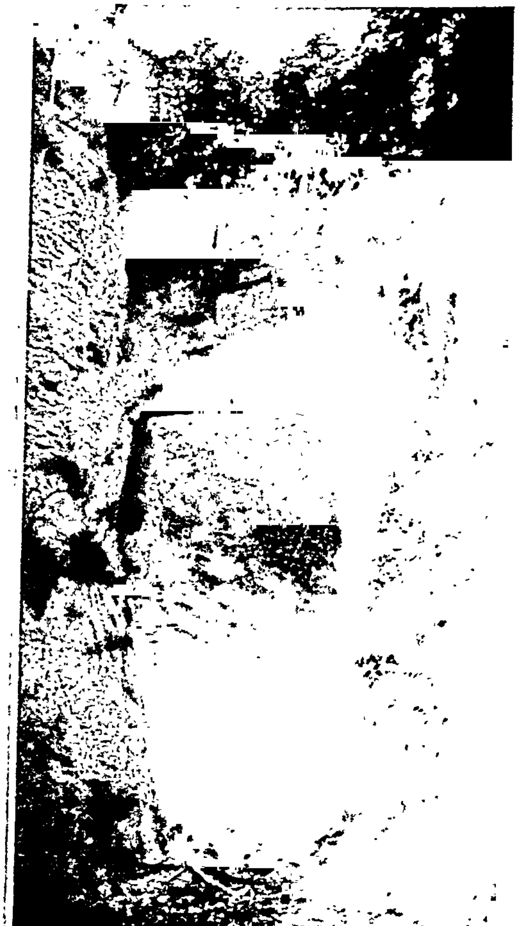
Streams also deposit their loads of eroded material when they come to lakes or the ocean Thus they build up gentle slopes or new land in the form of deltas



Niagara is an excellent example of what geologists call a *cap rock fall*. The block diagram at the right shows how the fall is formed. A hard top stratum of limestone prevents the upper part of the Niagara River from eroding its bed in the way other rivers do. Instead, it plunges over the edge of the cap rock, eroding softer layers of rock beneath. From time to time, this undermining causes big chunks of limestone to break off and fall into the plunge pool at the foot of the falls.







The Natural Bridge of Virginia was probably formed by water erosion of another sort. Geologists think that Cedar Creek originally flowed in a long loop around a low range of hills. In time the water found a subterranean path through the hills (shown by the broken line in the upper diagram). This tunnel became larger and larger until the roof at both ends began to cave in (lower diagram). Eventually, only a narrow arch of the tunnel roof was left. The Natural Bridge is one of the scenic wonders of the valley of Virginia.

HOW RIVER SYSTEMS DIFFER IN HUMID AND DRY CLIMATES

In regions where there is plenty of rain river systems form treelike *dendritic* patterns such as the one at the left The main stream and its tributaries have worn down V shaped valleys and have divided the land into pointed hills and ridges The right hand picture shows the drainage system in a desert region after a heavy rain Most of the small streams run dry before they reach the main river Note how running water has worn down a broad flat bottomed valley marked with benches and mesas.

The Mississippi River has built a large and famous delta in the Gulf of Mexico

Scenery Made by Streams

The hills ridges and mountains shaped by streams as they erode the land are often very beautiful So are the deep valleys and canyons which they wear away in high regions Every year thousands of people go to see the beautiful canyons cut by the Colorado River and other streams (*see* Grand Canyon)

Waterfalls also are made by rivers and creeks Niagara Falls for example began when the Niagara River eroded soft rocks under beds of strong limestone Thus it made an overhanging cliff where the water now plunges 167 feet into the lower part of the valley (*see* Niagara Falls)

Many waterfalls resemble Niagara but are not so spectacular Others were made where streams wore broken rocks into cliffs or where they flowed over hard rocks that cut across their channels The hard material acts like a dam making the water fall over it into the valley below The Lower Falls of the Yellowstone River in Wyoming plunge over such a natural dam

Streams sometimes make natural bridges by eroding tunnels through the ground When part of a tunnel roof falls in the portion that remains standing becomes a bridge of rock Natural bridges and arches in the Southwest were made when streams wore away the weak rocks at the bottom of cliffs but left higher beds that were strong Some arches and bridges are flat on top but others are curved and some are very high Those that consist of red or orange rock are exceptionally beautiful

Falls Rapids and Fall Lines

Usually at least one point along the course of a long river is marked by falls or rapids These form where the stream runs across a harder formation which does not wear down as rapidly as the rest of the stream bed At the downstream edge of the hard rock, the stream *descends rapidly* to a lower level beyond If the water drops straight down from the edge of the formation it forms a waterfall If it rushes down a steep course it forms rapids In the part of North America once held by the French a rapid is often called *sault* (pronounced soo)

In many regions a widespread hard formation ends along a fairly definite line and each large river has rapids or falls at this line Such a line is called a *fall line* The fall line of the Atlantic coast of the United States is particularly important Many of the great cities of the region are located on this line There are two reasons for this In colonial days the rapids marked the head of navigation and communities grew up there Later when manufacturing commenced the falls or rapids furnished water power for mills and the mills helped build the cities

Erosion in Dry Climates

In deserts and other dry places there is not enough water to make many rivers and creeks Those which do exist may dry up for months at a time only to carry a swift flow of water after sudden hard rains Even then desert streams often sink into the ground before they can flow into other streams

Desert streams wear down valleys with steep sides and often with broad almost level shelves on each side of the stream channel Hills and ridges between the valleys are steep Where they are covered with strong rock such as lava or sandstone their tops are flat Extensive flat-topped hills are called *mesas* (in Spanish tables ') small hills are called *buttes*

Most lands without streams are dry level plains that have neither hills nor valleys They are so flat that trees or houses can be seen for miles But where rivers have been flowing for ages the land is no longer flat Water has washed rocks and soil away eroding valleys that divide the land into hills and ridges Even mountains are made in this way if the land is very high and the streams erode very deeply

Wave Erosion Along Shores

We can watch oceans destroy or erode land when waves crash upon a rocky shore The waves force

WEATHER PARES DOWN SOLID ROCK

The elements are peeling this g anite boulder like a d ed onion. Weathering is a powerful fo ce in chang ng the face of a landscape W nd and ra n and alte nate pe ods of heat and cold combine to produce strange effects such as th s one

example were made by volcanoes that p led up lava where the ocean is more than three miles deep Lava is still coming out and the volcanoes are now more than two miles above the surface of the ocean

Some Results of Weathering

While erosion breaks material loose and moves it from higher places to lower ones the material itself is being changed Some rocks are broken down into sand and clay Others are dissolved completely

The erosive action of wind water heat and cold upon rock is known as *weathering* In places weather breaks ledges of stone into chips and sharp-edged blocks In other places it turns rocks into such fine grains that they become soil Weathering also makes many large stones peel off in curved fragments that resemble the layers of an on on

In especially dry regions water plays little or no part in weathering But wind laden with sand can cause deep erosion In such regions the bases of cl ffs are eroded more deeply than the tops because wind cannot raise its load of sand very high

Another kind of weathering takes place where water dissolves rock particles and carries them away This gives some rocks rough irregular shapes and makes holes in others *Solution* also produces caves wh ch extend into hills or go deep into the ground Stone Age men often lived in such caves and painted pictures on the walls (*see* Cave Man)

Most limestone contains some clay When water dissolves the stone this clay is left behind In time it covers the ground with a layer of dark red so l Red soil also forms where rocks of that color are weathered into fine sand and clay (*see* Soil) This happens in eastern Canada New England and New Jersey, as well as in the western United States

Changes in the Earth s Crust

IF EROSION proceeds through a long period of time without any thing else happening eventually it reduces almost all land nearly to sea level The leveling stops only when the land is so low the streams have scarcely any flow left to wear away more land This has happened many times in past ages over wide areas

Such a leveled-off surface is called a *peneplain* In most cases however the surface does not stay in this condit on very long Many localit es around the earth show that the surface does not stay at the same level age after age

How Earth s Surface Moves

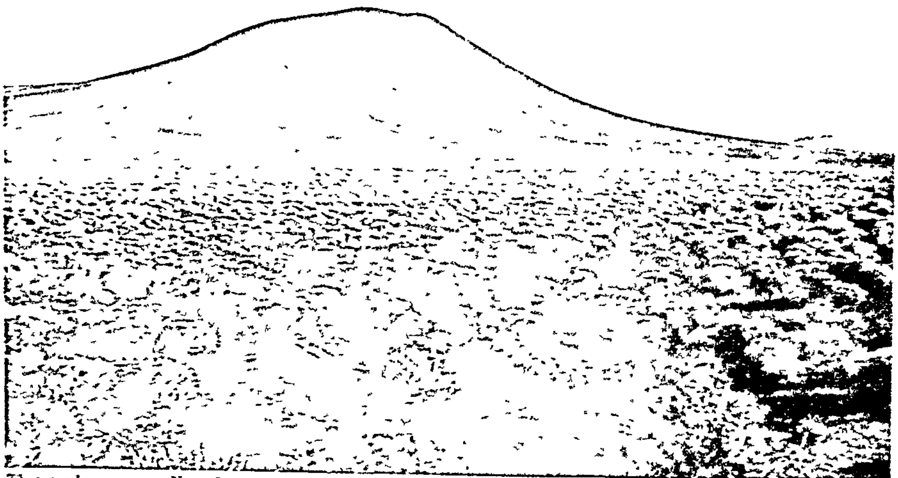
Anc ent forests of New Jersey grew on land but many now lie under coastal swamps Buildings that once stood on the island of Crete (*see* Crete) lie under salt water and so do many river valleys of New England eastern Canada and the Pacific coast Yet rocky reefs that once stood near sea level now rise as much as 60 feet above it and ancient docks now stand on dry land Rocks wh ch contain remains of corals oysters sharks and other creatures that lived in the sea now are found on prairies hills and mountains

This evi lence proves that the earth s surface moves both downward and upward The article on Geology gives some reasons why these movements occur Some internal process deep down in or below the crust may make the surface swell up like a huge blister In other local t es whole regions may sink nearer the center of the earth These movements

A STONE SENTINEL CARVED OUT BY WEATHER

Weather ng shaped this g eat p nnacle caus ng granite to crumble nto sand and c ay In one p ace weathe ng has bored a long hole through the p nnac e The wo n away material is becoming soil and already supports a few trees

A BARREN LANDSCAPE MADE BY VOLCANIC ACTION



This cinder cone in Nevada is a small volcano made of exploded lava. The plain in the foreground is also made of volcanic cinders. Like weathering, volcanic action changes the earth's appearance. Heat and pressure within the earth explode melted rock and drive it to the surface to form cones like this.

are called upward and downward *warping*. In still other places, the crust may act as though separated parts move toward each other along the surface, and squeeze intervening material into huge folds, which become mountains.

Some Effects of Warping

Warping raises or lowers large regions so gently that their rocks hardly seem to be tipped. Gentle *upward* warping has raised a strip of land called the Coastal Plain above sea level from New York to Florida and westward to Mexico. It has pushed the interior of North America upward again and again, for this region also consists of rocks which were formed largely under the sea.

The effects of upward warping often show prominently along seashores. Many raised shores show cliffs worn by ancient waves, rocks that once were little islands, and beaches or ridges made of piled up sand.

Downward warping, on the other hand, has allowed seas to spread again and again over regions that once were land. It also has made such valleys as the San Joaquin-Sacramento Valley in central California.

Folding and Faulting Make Mountains

Folding takes place when part of the earth seems to shrink, far down below the surface, and wrinkles the surface into great up and down folds. In some places, upward folding has produced long, low islands or rolling plains. More often, however, the upward folds have become so high that they formed mountain ranges (see Appalachian Highlands; Rocky Mountains; Geology). Some folds would rise as much as five miles if frost, streams, and other things had not worn them down.

Faulting occurs when rocks break as they move upward, downward, or sidewise. This may happen when folds are bent and squeezed until they can bend no more. They break in what is known as a fault—but the earth keeps on squeezing. It thrusts rocks on one side of the fault over those on the other, sometimes for many miles. Such thrust faults are important in the northern Rocky Mountains.

Other faults develop where huge blocks of rock heave upward or sink. Blocks that move upward form mountain ranges, while those that sink form valleys. The faults themselves are marked by cliffs which sometimes are smoothed or scratched where the rocks rubbed against each other as they went up or down.

How Faulting Causes Earthquakes

When the earth's surface warps, it generally shifts so slowly that the movement cannot be noticed. But when rocks break and move along faults, they do so suddenly and therefore cause earthquakes (see Earthquake). An earthquake which shook New Zealand in 1929 was caused when ground on one side of a fault was raised 15 feet and shifted 9 feet sidewise. During a Japanese earthquake in 1927, land was raised more than two feet along each of two faults that crossed one another. An Alaskan earthquake was caused by movements that raised some parts of the coast as much as 47 feet.

Such earthquakes are more violent than those caused by volcanoes. They are most destructive when they strike cities or cause huge waves to rush over lowlands and drown great numbers of people.

Volcanoes, Domes, and Lava Flows

Many masses, or pockets, of molten rock lie deep down in the earth. Sometimes they make their way to the surface, where they break out in eruptions of lava from volcanoes or cracks in the ground (see Volcanoes).

A volcano is a hill or mountain built up of lava. If the lava is soft when it comes from the ground, it spreads rapidly and makes a volcano that is wide and has gentle slopes. The great volcanoes of Hawaii were built in this way, and so were many smaller ones in the western United States. From a distance they look like saucers turned upside down.

When lava explodes it forms "cinders," which actually are rough pieces of stone that hardened very quickly. As cinders fall upon the ground, they form cone-shaped volcanoes which may be steep but seldom become very large. Cinder cones are common

in many parts of the West from Arizona to the state of Washington

Large steep cone-shaped volcanoes are built up by explosions of cinders that are followed by outpourings of soft liquid lava Then come more cinders and more lava flows until the layered volcano is thousands of feet in height Millions of years may go by as one of these volcanoes is growing

Another kind of mountain has been formed where molten rock came close to the surface but did not erupt Instead it piled up underground bending the older beds of rock that covered it Higher and higher they went until they became a dome under which the molten rock could harden into stone

Domed mountains may be seen in Wyoming Utah and other parts of the West Some still have their covers but others have been worn down until we can see their once-molten cores Though some cores are not very high others form peaks that rise thousands of feet above the surrounding country

Lava that erupted from cracks covers much more of the land than do domelike mountains or volcanoes Such lava often ran out of the ground in sheets that spread far and wide before they hardened Lava sheets built a high plain or plateau that now forms almost a quarter million square miles of the northwestern United States covering mountains as much as 2 500 feet high Other lava sheets which are much older form ridges and hills in the East

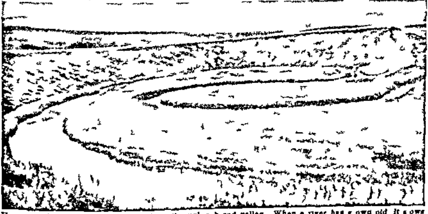
Most surprising of all are lava like rocks that did not erupt but hardened in cracks Such formations are called dikes When the ground around these crack fillings is worn away they often remain as ridges Some of the ridges are so straight and steep that people have mistaken them for prehistoric walls

Molten rock also has spread out in layers between older beds of stone These hardened layers known as sills have often been bent or steeply tilted When streams wear away the softer rocks above them such tilted sills are exposed to view The Palisades of the Hudson near New York City are the steep side of a tilted sill that is more than 60 miles long and as much as a thousand feet in thickness

A YOUTHFUL VIGOROUS RIVER

This deep V shaped canyon was cut into the earth by the young river that flows at its bottom 1 800 feet below Such young rivers are fast and full of rapids and the valleys they erode have steep sides

AN OLD TIRED STREAM IN ITS FLATTENED VALLEY

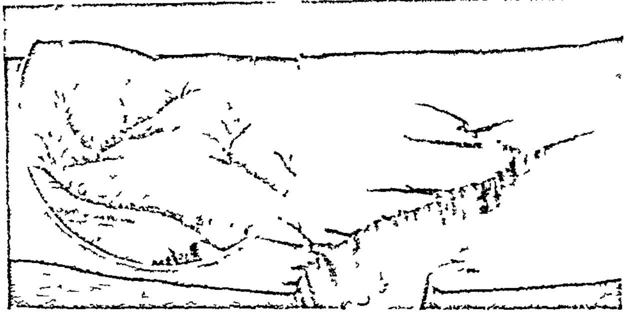


Here an old stream winds or meanders through a broad valley When a river has grown old it slows down and moves at a leisurely pace in wide scroll like curves By that time it has worn its valley down to a wide flat peneplain.

Streams from Infancy to Old Age

While the land is changing its appearance growing older streams that flow across it also go through a life cycle Many rivers begin when rain falls upon sloping land The rain water trickles into low places where it collects in rills that are infant streams The rills wash

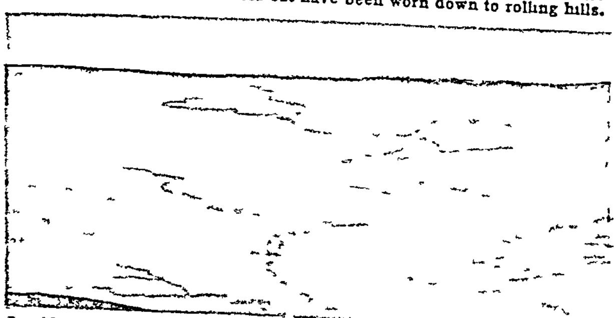
A RIVER FROM INFANCY TO OLD AGE



A stream starts life by forming rill marks on a slope after heavy rains (enlarged view, upper left). Many of these tiny streams join forces and cut a deep gully in the earth. Water flowing through the gully becomes a young river and cuts a deep, V-shaped canyon in the high plain.

Here the same river is somewhat older but still in its youth. Its valley is steep-sided and V-shaped, but the sharp angular outline is disappearing. Many tributaries have cut canyons before they join the main river. The canyon-cutting has dissected the original plain into mountains.

In middle age, the river flows more slowly through a wide valley. Part of the valley floor is now a flood plain, covered only when the river is at high stage. The youthful V-shape of the valley has disappeared. The mountains which the tributaries cut have been worn down to rolling hills.



In old age, the river meanders from side to side over a broad flood plain. It constantly widens its loops by cutting away their outer banks and depositing the eroded material in bars along the inner banks. Notice the filled-in abandoned channels and the oxbow lake formed by a cut-off. The sides of the valley have scarcely any slope left.

grains of soil away as they flow downhill, taking these grains of soil with them as they go. They also remove weathered stone, clay, and other materials. In this way they dig out infant valleys which are known as rill marks and gullies.

This process goes on until the largest rills become creeks, or brooks, and the largest creeks turn into rivers. Each young river flows swiftly and erodes so fast that its valley becomes deep and narrow, with steep sides that come together like a huge letter V.

Very young valleys, which are known as ravines, canyons, or gorges, may be worn in almost level land. Many of the great canyons in the southwestern part of the United States, such as the Grand Canyon of the Colorado River and Bryce Canyon, are of this type. (For pictures of these canyons, *see* National Parks.) Often, however, other streams divide the surface into valleys and mountains or hills. Where these streams flow into the young river, they erode V-shaped notches, or ravines, in its canyon walls.

In time the young river becomes middle-aged. Its valley is worn wider, with gently sloping sides and a flat bottom. Large tributaries flow into it; smaller rivers and creeks flow into the tributaries. They form the familiar branched (dendritic) pattern.

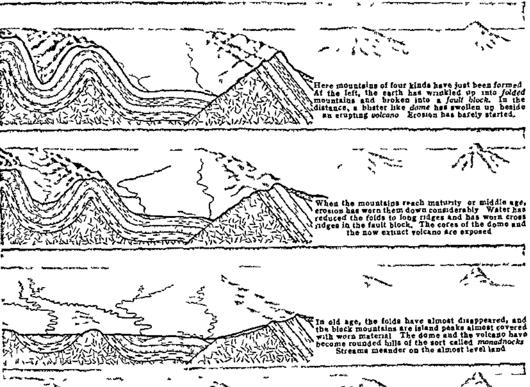
As the river grows old, some tributaries disappear. The sides of the valley become gentle slopes, while the valley bottom is made wider and wider. The river itself flows slowly and is broad and shallow; it winds in curves called *meanders* across its flood plain. As the water swings around the curves, it wears material from the outer side of each meander. The river does not flow fast enough to wash all this material away, and much of it settles in bars in the middle of the stream and on the inner sides of meanders.

In the picture of worn-down mountains on the opposite page, an old river winds across land that was once folded mountains. If the region is uplifted, the stream is "made young again" (rejuvenated). It then flows rapidly, wears rocks from its banks and its channel, and begins again to make a steep-sided, narrow canyon. But the river still flows in the wide, meandering curves it had made before the land was uplifted.

How Mountains Grow Old

Let us picture a region that contains mountains of several kinds. In the distance are a volcano and a dome. Near by are a folded region and a ridge that is really a tilted fault block. At first all these mountains are "young." This means that they look much as they did when they were formed. Then weathering begins to work, rain falls and runs down

THE *LIFE* HISTORY OF FOUR KINDS OF MOUNTAINS



Here mountains of four kinds have just been formed At the left, the earth has wrinkled up into *folded* mountains and broken into a *fault block*. In the distance, a blister like *dome* has swollen up beside an erupting *volcano* Erosion has barely started.

When the mountains reach maturity or middle age, erosion has worn them down considerably Water has reduced the folds to long ridges and has worn cross ridges in the fault block. The cores of the dome and the now extinct volcano are exposed

In old age, the folds have almost disappeared, and the block mountains are island peaks almost covered with worn material The dome and the volcano have become rounded hills of the sort called *monadnocks* Streams meander on the almost level land

Now the region is *rejuvenated* (lifted above the surrounding land) Streams are making new ridges of the folds the fault block is a high ridge of island peaks, and the monadnocks stand on platforms Streams are making canyons in their old wandering channels

slopes, and streams wear rocks away They change the shape of the volcano, make it lower, and erode deep valleys in its sides They remove the bent rocks that cover the dome, and turn its core into a mountain with valleys running down its sides and a peak at the top

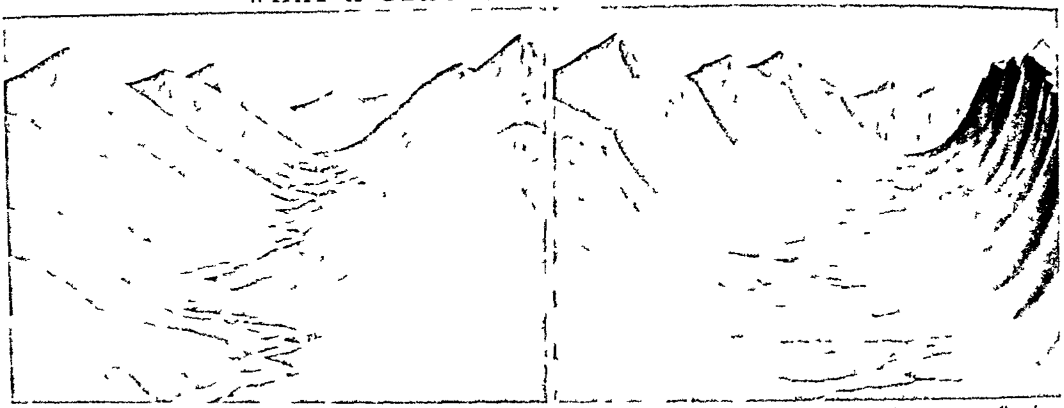
Streams that begin to run on the folds wear weak rocks much faster than those that are strong In this way they produce valleys and ridges that are almost parallel Smaller streams that run down the sides of the ridges make openings or gaps, in them In time, streams flow through these gaps from one valley to another, forming what are known as water gaps (The Appalachian Mountains have a noted ridge-and-valley section made in this way)

Streams also flow down both sides of the fault block, but those on the steep side flow faster and erode more rapidly They cut the block into cross ridges, which then are worn into peaks Streams also deposit clay, sand, and larger stones in low places At last these deposits become so deep that they cover the foot of the mountains and begin to fill the valleys between ridges and peaks

At this stage the mountains are mature, or "middle-aged" As weathering and wearing continue, they slowly become old The volcano and dome almost disappear, only their hardest rocks remain in the form of knob shaped hills called *monadnocks*, after an old mountain in New Hampshire The folds also are worn away, and rivers wind across what once were rocky ridges The block mountains become smaller and smaller, while more and more material is deposited around them At last they are only small "island" peaks which stand in the middle of broad slopes of clay, sand, and worn stones This stage marks their old age

Once mountains become very old they almost stop changing But sometimes the old region is raised, probably by gentle arching Weathering now destroys more rock, streams begin to flow faster and wear the

WHAT A GLACIER CAN DO TO A VALLEY



At the left is a V-shaped valley among mountains which have been somewhat worn by water. At the right is the same valley after a glacier has deepened its bottom and gouged out its sides, making it U-shaped. The glacier also scooped out basins that are now filled by connected lakes. Such U-shaped valleys and chains of lakes are common in Canada and in the northern United States.

rising land away. The mountains are rejuvenated, or "made young" again.

They do not go back, however, to their original form. The monadnocks do not become cones or domes again. They and the island peaks merely sit on top of new mountains that are left as streams erode the land. In the folded area, streams make new mountains as they wear away weak, tilted rocks.

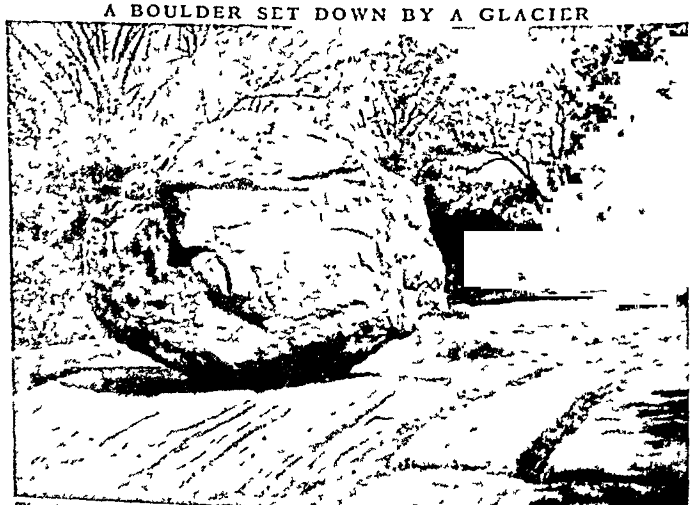
Glaciers Wear the Land

Glaciers are streams or sheets of ice that move down mountain sides, through valleys, or over hills and plains. Their ice picks up soil and loose stones, pries out rocks, and breaks off ledges. The ice mixes this material and scrapes it over the ground, forming grooves (*striae*) on rocky surfaces.

Where glaciers begin to move down mountains they dig deep basins called *cirques*. Sometimes several glaciers dig cirques in a mountain, cutting it into a sharp "horn" peak.

From the cirques, the glaciers go into stream-made valleys. Ice wears the valleys deeper, widens them at the bottom, and makes their sides very steep. They become U-shaped, like the glacial canyons in Banff and Yosemite National Parks (*see* National Parks).

A BOULDER SET DOWN BY A GLACIER



This tremendous boulder was ripped from the side of some distant mountain by an Ice Age glacier. Originally an irregular chunk of rock, it was rubbed smooth, and then dropped when the ice melted. The boulder lies on rock that was also scraped and grooved with *striae* by ice moving over it.

Glaciers of the Ice Age

Glaciers once formed in northern Canada (*see* Ice Age). They grew into huge sheets that spread to Kentucky, Montana, and the Arctic Ocean. In the north central and northeastern parts of the United States they filled the basins of the Great Lakes, covered lowlands, and moved over the tops of hills and many eastern mountains.

These ancient glaciers scraped cliffs down into low ridges, scoured hills until they became round knobs, and ground vast amounts of rock to pieces. When they finally melted, they left most of this ground-up material in low places. Thus they filled many valleys and low plains after wearing the high places down

The Ice Age glaciers did not make the land quite smooth. They also scraped out countless basins, and they left much of the worn rock in ridges or small hills. As water filled both basins and depressions, it formed swamps and lakes. Lakes in the "north woods" of Minnesota and Canada were produced this way.

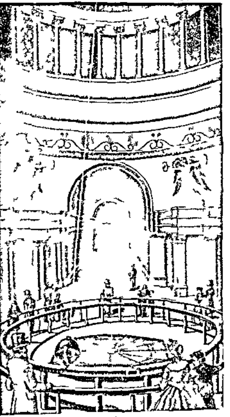
At first, such lakes had neither inlets nor outlets, and many have none today. Others finally overflowed, and their water ran to the next lake, the next one, and so on until it became a river. One of these rivers is now the Mississippi. It flows through several glacial lakes before it finally turns southward (*see* Mississippi River). It is now busy changing land that was scraped down and then covered with piles of broken-up rock left by melting glaciers.

How Men Gained Accurate Knowledge of the Earth

MEN have not always known the truth about the size and shape of the earth. Almost 4,000 years ago learned men of Egypt pictured the earth as the bottom of an oblong box whose top was the sky. Ancient Hindus did not agree to them; the earth was a disk or hemisphere that rested upon the backs of four huge elephants. The elephants in turn stood on a turtle which swam forever in an endless sea. The Greeks of Homer's time (about 850 B.C.) thought the earth an irregular disk that floated in endless waters, which they called the River Ocean. On the disk were mountains, hills, lowlands and streams, lakes and seas.

Pythagoras (who lived about 525 B.C.) may have been the first to say that the earth was spherical. But within 150 years astronomers provided proofs like those given early in this article. By 250 B.C. most learned Greeks were sure the earth was a sphere. One astronomer, Aristarchus of Samos, believed that it rotated and revolved around the sun. Eratosthenes, a Greek who lived in Egypt, measured the earth's circumference with an error that probably was not greater than 2,500 miles and may have been much less. We can not be certain because we do not know the exact value of his unit of distance, the *stadium*.

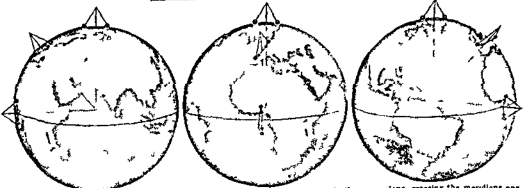
PROOF THAT THE EARTH ROTATES



Ptolemy (about A.D. 150) believed the earth to be smaller than it is and decided that it did not rotate. He believed also that the *earth stood still in the center* of the universe and that the other heavenly bodies revolved around it. Unfortunately his ideas were accepted for 1,400 years.

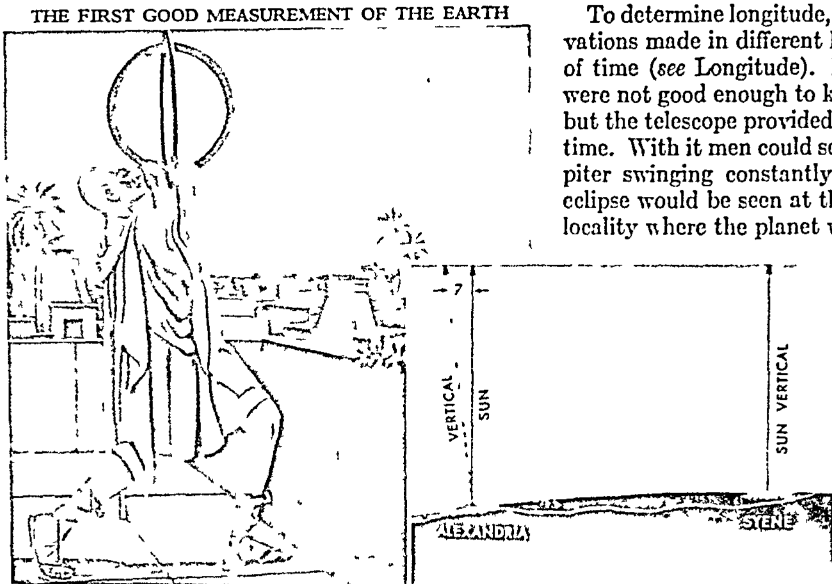
During that time many people also held to old beliefs that the earth was square or circular and flat. Learned men in the Middle Ages, however, knew it to be round. When Magellan's ships sailed around the world in 1521 and 1522, it was no longer possible to doubt that the earth was round. Later in the century Copernicus argued that the earth and other planets traveled around the sun. About 1600 Johann Kepler discovered the whole truth.

He found that the planets, including the earth, travel around the sun in elliptical orbits (*see* Astronomy; Copernicus; Kepler). The earth's orbit has an average diameter of 185,800,000 miles and a circumference of more than 5,840,000,000 miles. At one point on its elliptical orbit (the *perihelion*) the earth is 91,400,000 miles



Foucault's pendulum experiment (top picture) showed proof to observers that the earth actually rotates. The bottom pictures show how it performs at different latitudes. At the left, three pendulums are set swinging north and south along a meridian. The other pictures show the pendulums four hours later (center) and eight hours later (right). The pendulum at the pole has continued to swing *in exactly* the same plane, crossing the meridians one by one. After 24 hours it will be swinging over the original meridian. At the equator the pendulum continues to swing on the meridian because the earth does not actually turn under it. At Paris, between these points, the pendulum makes a compromise and turns *the direction of its* swing through 11 degrees every hour.

THE FIRST GOOD MEASUREMENT OF THE EARTH



Eratosthenes in Egypt made the first scientific estimate of the earth's size. He found that when the sun was overhead at Syene (Aswan), it was about seven degrees (1/50 of a circle) from the vertical at Alexandria. So he computed the earth's circumference as 50 times the distance between the two cities His estimate (about 24,500 miles in modern figures) was remarkably accurate for his time.

from the sun, at another point (the *aphelion*), it is 94,500,000 miles

Later in the 17th century, Sir Isaac Newton discovered that planets stay in their orbits because of a force called gravitation (*see* Newton; Gravitation). In 1728 James Bradley found unquestionable proof that the earth goes around the sun by discovering the *aberration of light*, as told in the article on Astronomy.

One of the most striking proofs that the earth rotates on its axis was devised by a French physicist, Jean Foucault, in 1851. He hung a heavy iron ball by a wire more than 200 feet long from the dome of the Panthéon in Paris. Around the bottom of this pendulum was a circular railing piled with sand. Each time the pendulum swung, a projecting needle knocked a bit of sand from the rail.

Physicists know that when a long pendulum swings freely, it tends to move hour after hour in the same plane. If the earth did not turn on its axis, therefore, Foucault's needle would have continued striking the sand in the same two places. Instead, it made new lines every time the pendulum swung. Since there was no force at work to make the pendulum change its swing, the different marks could only be caused by the earth rotating beneath the pendulum.

Accurate Measurement of the Earth

By 1600 men were sailing all around the earth and needed accurate knowledge of its size and shape. The discovery of the telescope gave them the means they needed for precise measurements. With it they could measure altitudes of the sun and the stars above the horizon with extreme accuracy, and from the altitudes they could determine latitude (*see* Latitude and Longitude).

To determine longitude, they had to compare observations made in different localities *at the same instant* of time (*see* Longitude). In the 17th century clocks were not good enough to keep accurate track of time, but the telescope provided another means of checking time. With it men could see the many satellites of Jupiter swinging constantly into eclipses. Since each eclipse would be seen at the same instant from every locality where the planet was visible, the observation was a good means of fixing longitude.

Such measurements determined locations accurately in angular measure—that is, degrees of latitude and longitude. For a measure in miles or other unit of length, it was necessary to do what Eratosthenes had done—compare a *measured* distance between two points on the earth with the *angular* difference between the same points. In 1671 Jean Picard made a good measurement of this sort using the meridian between Amiens and Paris.

This measure and others like it could be used anywhere if the earth was a perfect sphere. But Newton believed that it was an *oblate* spheroid (bulged at the equator). Others argued that it might be a *prolate* spheroid (bulged at the poles). In 1735, to settle the question, the Paris Academy of Sciences sent out two expeditions. One went to Peru (now Ecuador) and spent ten years measuring a north-south line among mountains near the equator. The other expedition went to Lapland, where they measured an arc in dense forests and upon the surface of a frozen river.

These measurements proved that the earth is oblate. The equatorial circumference and the polar and equatorial radii are given to the nearest mile on the first page of this article.

These figures are for an *ideal* earth—that is, one on which all oceans and seas stand at the same level, and all land is considered as if it lay at sea level. The actual surface does not meet these conditions, but scientists are sure that the ideal figure is known to within one-tenth of a mile. The two figures commonly used today are the Hayford spheroid, computed in 1909, and the International Ellipsoid of Reference (1924). They differ by only three meters (about ten feet) in the length of the polar radius.

Measuring the Mass of the Earth

In 1798 Lord Cavendish of England determined the earth's mass. The determination amounted to what many people call "weighing the earth"; but since the earth cannot be put on a scale, Cavendish attacked the problem indirectly.

First he measured the gravitational attraction of the earth for a large ball of lead. Then, using a

specially designed balance, he measured the attraction of the large lead ball for a smaller one From these two measurements as well as the distance from the center of the earth and that between the two lead balls, Cavendish accurately computed the mass of the earth In 1941 and 1942 Dr Paul R Heyl of the United States Bureau of Standards repeated the Cavendish experiment With more refined data he determined the earth's mass as 5.96×10^{27} grams, or about 6 570 000 000 000 000 000 000 short tons

These huge figures give a clue to the earth s *density*—that is, the amount of material ("matter) in a given amount of space Dividing the mass of the earth by its volume gives the weight of one cubic mile of earth material as 22 870 million tons This is 5 52 times the weight of a cubic mile of water, and so the density of the earth is said to be 5 52

This figure is an average for the entire planet Actually the earth is only moderately dense at the surface and much denser at great depths Figures range from 2 7 or 2 9 at the surface to 9 at a depth of 1,800 miles and 11 6 or 12 at the center

The 'Spheres' of the Earth

Scientists often speak of the earth's "spheres" These are really shells (concentric layers) which show differences in composition The core of the earth is the *centrosphere*, the intermediate layer, or outer mantle, is the *asthenosphere* and the rocky crust the *lithosphere* In depressions of the crust lies the *hydrosphere*—the watery areas of the earth Surrounding all is a gaseous blanket, the *atmosphere*

The dimensions of the 'spheres," or shells, are determined in various ways The hydrosphere can be measured with the deep-sea lead, but the most useful device is the sonic depth finder (*see* Navigation) For the atmosphere, reflected radio and short waves give much information Observing instruments can be carried up by balloons and jet-propelled missiles Visual observation and photography are used for the aurora and for meteors

For the interior of the earth scientists use the shock waves sent out by earthquakes These waves travel in all directions, and those that go downward gain speed rapidly to a depth of 600 to 650 miles Then the rate of increase falls off, as it should when waves leave the dense-rock shell and enter the one that consists largely of metallic compounds At 1 800 miles the waves change speed again, dropping from more than eight miles to about five miles a second Indeed, some waves are entirely absorbed, a fact which indicates that the nickel iron core is doughy instead of solid

In 1913 A A Michelson and others, of the University of Chicago, proved that the earth as a whole is as rigid as steel To do so he measured the tiny tides in a 500-foot pipe half filled with water These tides rose to only about 70 per cent of their predicted height Some other force was tilting the pipe in the same direction Michelson correctly supposed that this force was a tide in the solid earth The extent of this *terrestrial tide* gave him his figure for the rigidity of the earth

Balance Between High and Low Places

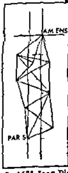
Many tests and measurements prove that the continents and ocean basins rest upon dense rocks which make up most of the earth s crust Measurements made with plumb lines and delicate pendulums show that material under plains is heavier than that which makes up high mountains Other measurements prove that rocks under oceans are also very heavy

These heavy rocks have been solid for ages, but *nevertheless they can move They can be squeezed* downward forced sidewise or pushed upward under the outermost parts of the crust The continents and ocean basins seem to float upon this dense layer When part of the surface becomes heavier, as by the deposit of eroded material, it sinks into the lower layer The dense layer also rises under some other part of the surface This floating balance is called *isostasy* from Greek terms meaning "to stand equally" It is explained more fully in the article on Geology

The Origin of the Continents and Oceans

A related question is how continents and ocean beds came to be located where they are The problem is complicated because the locations have varied greatly

PICARD MEASURES A DEGREE OF LATITUDE



In 1671 Jean Picard made the first useful measurement of a degree of latitude He measured the distance between two towns in France by triangulation (inset diagram) and took sights on a star to find the difference in latitude in degrees By combining his results he learned the length of a degree of latitude

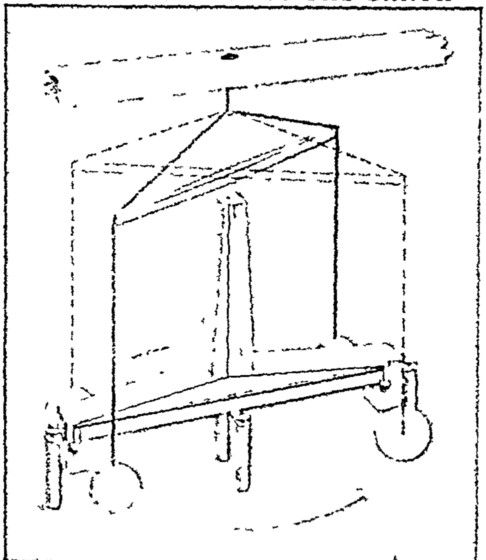
through the geologic ages. In earlier times, for example, continental land masses tended to form belts running east and west. Today the continents are substantially triangles, with their bases to the north and their tips to the south.

In earlier times, when men believed that the earth once was molten and cooled slowly, one theory explained the formation of continents by stating that they were the first parts of the crust to lose heat and solidify. Scientists thought that when the rest of the surface hardened, the earth had shrunk. So these parts were lower than the continents and became ocean basins.

T. C. Chamberlin, one of the men who devised the planetesimal hypothesis, suggested that dense planetesimals formed some parts of the earth while light ones formed others. The dense regions sank downward and became ocean basins. Light areas were forced upward until they became continents and such large, old islands as Greenland.

According to a third theory the earth once was molten but its surface quickly hardened into a crust of granite and other light rocks. In time the crust cracked, allowing heavy lava to erupt over great areas. These areas sank, turning into ocean basins. Lighter regions between them remained where they were or pushed upward, forming continents.

CAVENDISH WEIGHS THE EARTH



This picture shows the apparatus Cavendish used to compute the earth's mass. He determined how much a large lead ball attracted a small lead ball which was allowed to swing freely toward it. He already knew the mass of the two spheres and the gravitational attraction of the earth for them. From these facts he computed the total mass of the earth.

Meanwhile, an American and an Austrian geologist suggested that the continents had drifted to their present positions. The Austrian, Alfred Wegener, pictured one huge early continent that began to break up about 250 million years ago. Its sections then moved over a fluid layer which might have been melted by radioactive heat. North and South America drifted westward; Africa pulled away from Europe; Antarctica went to the South Pole. Asia swung northward, while Australia drifted far to the east.

Each of these theories explains some facts, but fails to explain others; and objections can be found to all of them. The continental-drift theory meets the objection, for example, that centrifugal force ought to have sent drifting masses toward the equator. Nevertheless, the theory inspired a program of world-wide time checks by radio to determine whether the longitudes of selected points are changing.

The Earth, a Powerful Magnet

It has long been known that the earth is a huge magnet. Like other magnets, it has two poles with lines of force running between them (*see* Magnet). For at least 800 years, and probably much longer, men have used these lines of force in the magnetic compass to tell directions (*see* Compass, Magnetic).

The magnetic poles of the earth do not coincide with the true North and South Poles of the earth. They are difficult to locate because they are in inaccessible regions and because they are constantly changing position. The north magnetic pole is somewhere in the region north of the Boothia Peninsula of Canada. The south magnetic pole is in the Australian territory of Antarctica.

The Earth Is Very Old

Geologists and other scientists have long concerned themselves with the problem of the earth's age. John Joly, an Irish geologist, based his estimate on the time needed to accumulate all the salt in the sea. He concluded that this must have taken at least 90 million years. Sir Archibald Geikie and other geologists tried to determine the earth's age from the thickness of rocks that settled in lakes and ancient seas. Such estimates have ranged from 100 million to one billion years. Lord Kelvin, a British physicist, estimated that it may have taken the earth's crust about 100 million years to cool.

The newest and best estimates are based on rocks which contain radioactive elements. These elements turn into lead at rates that never change (*see* Radioactivity). Geologists have found radioactive rocks that show evidence of being more than 2 billion years old. Since these are not the most ancient rocks, the earth itself must be older. Some astronomers estimate the earth's age at 3 billion years.

How Will the Earth End?

Almost everyone has wondered at some time or other when the end of the earth will be. Some scientists have thought that the sun would eventually burn out and that the earth would perish for lack of heat. But radioactive materials in the sun should keep it hot for untold billions of years. And the earth itself is kept warm by radioactivity within its crust.

Other scientists have thought that the world would end through collision with a comet or a star. But not many years ago, the earth passed through part of a comet and no one felt it. The chances against collision with a star are inconceivably remote.

A more likely probability is that the earth will finally stop rotating. Then one side would have perpetual light and terrific heat, and the other perpetual darkness and unbearable cold. Life as we know it

now could certainly not exist The earth is actually slowing down, but at a rate of only one second in 100 000 years This would allow several trillion years before the end A more genuine cause for concern is the chance that man may destroy himself or civilization through atomic war This is a real possibility If men learn to live together in peace however they may inhabit the earth until its natural end

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WHY *and* WHERE EARTHQUAKES *Take* PLACE

EARTHQUAKE To understand earthquakes we must have in mind the general makeup of the earth s crust This crust estimated to be about 50 miles thick is composed of blocks or slabs of rocky material lying in irregular layers and piles To get an idea of its pattern think of a city dumping ground with its heaps of masonry bricks tiles slate mortar and stone that have been carted away from wrecked buildings and have gradually been packed down more or less solidly Just as the material on the dumping ground will show some traces of regularity because of the order in which the various kinds of materials were dumped so the pattern of the earth s crust shows traces of its original structure and makeup

The earth s crust as we find it today represents the wreckage of the far more even and orderly surface that existed billions of years ago Shrinkings and swellings in the interior of the earth and in the crust itself caused the crust to crack and buckle Great layers of rock split off and slid over one another some tilted up and stood on edge forming mountains others were ground and squeezed into small fragments (*see* Geology Rock)

As time went on the tremendous upheavals that changed the entire face of the earth diminished and the fragments of the crust settled down into more or less permanent position Here and there however areas of rock were left imperfectly supported or out of balance ready to slip or crack if disturbed in any way The disturbance may be due to further shrinking to pressure from below to volcanic explosions or to the additional weight of loose material piled above that area by the action of water Whatever the cause if the movement in the rock area is sudden it produces an earthquake or temblor The movement may consist of a slip along an old crack or fault or it may result in new faulting in the crust

As we would expect the conditions that produce earthquakes are more likely to be found where the crust of the earth remains most uneven that is in regions where high mountains exist near very low areas The low areas may be dry land valleys or they may be great deeps in neighboring oceans

WHEN THE EARTH OPENS

A concrete highway 18 inches thick was tossed into a jumbled mass of boulders by the earthquake at Fukui Japan in 1948 Crevasses five feet deep opened beneath the road

If we examine a map showing heights and depths the world over we can easily pick out the most conspicuous of these regions They lie along the Pacific coasts of North and South America west of the Great Basin and along the eastern coast of Japan They include the islands of the East Indies the West Indies and the middle Pacific which are the tops of great mountain ranges rising from the ocean beds Others lie along the southern edge of the Himalayas and along the mountainous promontories—Italy and Greece—that jut southward into the Mediterranean Sea

These and similar regions make up what geol

ogists call the earthquake belts. They also contain most of the world's active volcanoes (see Volcanoes). About 8,000 earthquakes are recorded each year the world over. Japan has an average of three a day. Most earthquakes do no damage. Even during violent quakes the solid crust of the earth usually moves very little—from half an inch to 2 inches horizontally. Loose overlying soil, however, may shift 20 feet or more. Then fissures are likely to open on the surface; buildings standing on the shifting areas will tumble down and water mains, gas pipes, and electric cables will be broken, with the added danger of fire, as in the San Francisco earthquake in 1906.

Quakes Beneath the Ocean

Submarine earthquakes may cause huge waves that carry destruction far inland. In the Lisbon earthquake of 1755, waves 60 feet high drowned many thousands within a few minutes. In 1946 a series of earthquake waves struck the Aleutians, the Hawaiian Islands (devastating Hilo), California, and Chile. Small islands may disappear during earthquakes. Changes in land levels may result. Near New Madrid, Mo., in 1811–12, new marshes and lakes were created.

Three types of construction permit buildings to withstand earthquakes. Small dwellings are made of light framework which can rock and shift without collapsing. In heavier structures, supporting members are placed beneath the middle instead of beneath the ends of the crossbeams, so that the beams can shift without slipping off their supports. In the third type the building "floats" on roller bearings placed under the main pillars. The bearings are steel plates with interposed sets of rollers at right angles.

The area of most violent movement, over the point in the crust where the earthquake originates, is called the *epicenter*. From this area, shocks and vibrations of diminishing force radiate in all directions. By measuring these vibrations with instruments called *seismographs* (*sīz'mō-grafs*) or *seismometers* at various points on the earth's surface, it is possible to locate the center of the disturbance. A seismograph consists of a massive weight suspended so that its movement relative to its support can be measured. A quake tends to vibrate the support and recording apparatus but leave the weight motionless.

Seismology, or earthquake science, gives us our most reliable information about the make-up of the earth's interior by measuring the speed with which vibrations travel through it. It is important also in engineering. By studying the character of shocks, engineers are able to construct dams and pipelines that will withstand them. One reason the United States built a canal across the Isthmus of Panama rather than across Nicaragua was that the former site is somewhat freer from earthquakes than the latter.

Some Notable Earthquakes

1755. Lisbon, Portugal. Sea waves produced by quake destroyed the city with loss of about 40,000 lives.

1811–12. New Madrid, Mo. Reelfoot Lake in Tennessee and Kentucky formed by the sinking of a part of the flood plain of the Mississippi.

1886. Charleston, S. C. Twenty-seven lives lost. The shock was felt over a very great area.

1891. Mino and Owari, Japan. Killed, 7,273; injured, 17,393; wholly destroyed, 197,000 houses.

1897. Bengal and Assam, India. Thirty lakes produced by tremendous changes in ground level.

1906. San Francisco, Calif. Violent quake, with surface movements up to 23 feet, followed by fire; about 500 killed; property damage, $500,000,000.

1908. Calabria and Sicily. About 76,000 killed, 95,000 injured; most of Messina destroyed.

1915. Central Italy. About 30,000 lives lost and 372 towns and villages damaged.

1917. Guatemala. Repeated earthquakes over a week's period killed about 2,500 persons.

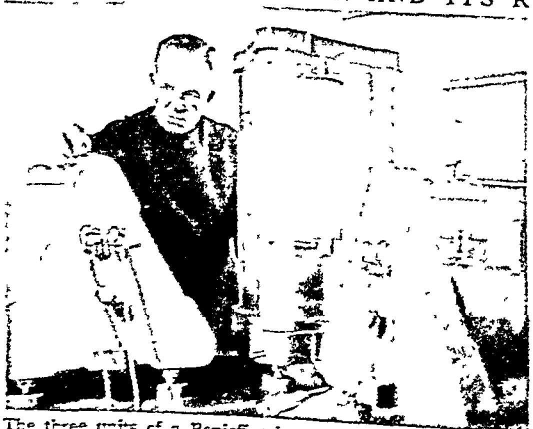
1920. Kansu Province, China. Violent quakes covering over 300 square miles; 200,000 lives lost.

1923. Tokyo and Yokohama, Japan. Nearly 100,000 killed and both cities wrecked.

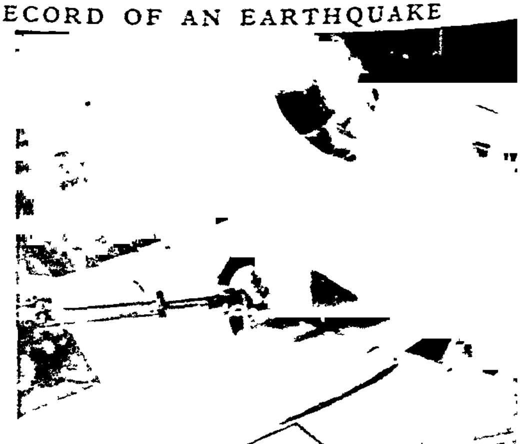
1929. Newfoundland. Quake offshore produced waves 100 feet high; 26 drowned; 12 ocean cables broken.

1931. North Island, New Zealand. Destruction along 45 miles of coast; Napier harbor raised; 250 killed.

A SEISMOMETER AND ITS RECORD OF AN EARTHQUAKE



The three units of a Benioff seismometer record East-West, North-South, and vertical movements of the ground.



The photographic trace made by the seismometer is studied with a microscope for analysis of an earthquake.

1934 Bihar Province India About 7 000 killed 400 000 lost livelihood from sand spread over fields

1935 Ind a Cities of Quetta and Kalat destroved floods gushed from fissures 30 000 dead

1939 Ch le Fert le central valley devastated Concepción Chillan other cities wrecked 25 000 killed

1939 Turkey Region extending 200 miles inland from Black Sea ruined 45 000 dead

1949 Ecuador At least 50 towns and villages destroyed about 6 000 killed 100 000 left homeless

1950 Assam India One of the most intense of all time 1 000 killed in thinly populated area

1953 Ithaca Zante and Cephalonia (Ion an Islands off west coast of Greece) Towns and villages leveled leaving 100 000 homeless at least 600 dead 5 000 injured

1954 Orléansville north central Alger a Town destroyed 1 310 dead about 5 000 injured

EARTHWORM The earthworm is nature s plowman It turns the soil over and over and breaks it up A farmer does the same thing with his plow The earth worm does its work by eating the so l in order to get tiny bits of leaves and other plant and animal matter out of it Scientists estimate that there may be more than a mill on worms in an acre of la d Many tons of earth pass through their bodies in the course of a year

Plants would have a hard time growing without this little farmer It lets air and water get to the plant roots It turns under decayed plant and animal matter Earthworms bury two inches of this material every ten years They also improve the soil with lime from the r own bodies Worms are so important to good plant growth that there are now worm farms where they are raised for sale

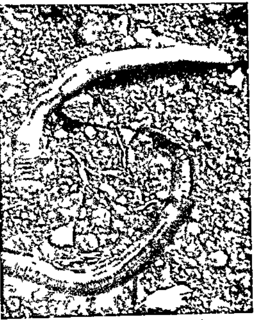
The earthworm s body is made of one tube inside another The outer tube is divided into parts or segments Under each segment are four pairs of bristles With these bristles and two sets of muscles the earth worm moves about

How the Earthworm Squirms Along

One set of muscles runs the length of the body The other set runs around the body The worm can make its body longer by relaxing the long muscles and shortening the other ones It can shorten its body by pulling in the long muscles and loosening the others To move forward it gr ps the d rt with the bristles under the tail end of its body Then it lengthens the body This action pushes the head for ward through the dirt Then the worm grips the d rt under its head and pulls up the tail end of its body

The inner tube is the digestive system The worm eats by turning its throat inside out and pushing it forward to grip a piece of d rt Then the throat muscles draw the dirt back into the tube The dirt goes first into a storeroom called the *crop* Then it goes into the *gizzard* Here the worm uses grains of sand to grind up the so l Next the worm d gests the food Then the worm pushes the dirt from its body It comes out in fine coils called castings

An earthworm has no eyes but it can tell light from darkness It feels the lightest touch It can do these things because it has sense cells on the outside of its body Its sense of taste is very sharp It breathes through its skin



TWO EARTHWORMS HUNT NEW HOMES
When the earthworms come out to the surface of the ground on a wet morning they are probably traveling to better feeding grounds over the moist earth In heavy rains they come to the surface if their burrows fill with water

Each worm is both male and female The worms work in pa rs though to fertilize each other s eggs Near the front of the body is a s vell ng called the saddle Here the worm forms a case around its body The worm lays eggs in the case The case works forward At last it sl ps over the head The two ends snap together The case is now a light brown capsule with the eggs inside It is about as big as a grain of wheat

The eggs hatch in about two weeks The young worms are less than an eighth of an inch long They take about two years to grow to their full ten inches Some worms in tropical lands gro v 4 to 10 feet long

Earthworms l ve where the soil is fine and moist They dig burrows usually 12 to 18 inches below the surface but they may be as deep as eight feet The burrow goes straight down at first then winds about irregularly Each burrow ends in a little room Here one or more worms curl into a tight ball and sleep (hibernate) through the winter They keep rain water out by blocking the opening of the burrow with leaves In heavy rains they come to the surface to avoid being drowned When they get overcrowded they come up and look for new homes They must be able to go underground quickly The ultraviolet rays of sunlight soon kill them.

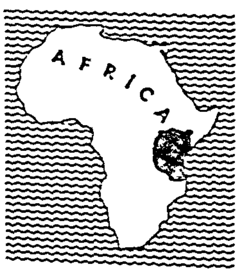
The greatest enemies of earthworms are birds and moles The worm however has one advantage in its

struggle to live. If a robin tugs at a worm and breaks it in two, the worm may not die. The part which remains underground may grow a new part to replace the missing head or tail end. This is called *regeneration*.

About 90 species of earthworms are found in North America. Most of them belong to the genus *Lumbricus*. Many related species are found in fresh or salt water. The ringed, or segmented, body of the earthworm places it in the phylum of the animal kingdom which is called *Annelida*, or *Annulata*. This name is from the Latin word *anellus*, meaning "little ring." (Relations of the annelids to other animals are shown by a diagram in the article Animals.)

AFRICA'S HIGHEST MOUNTAIN
The snowy cap of Kilimanjaro looms over the fertile farms of the East African plateau. The mountain is in Tanganyika.

EAST AFRICA, BRITISH. Snow-capped mountains, rich farm lands, tropical forests, and rolling grasslands with an abundance of game animals are all typical of Britain's territories on the East African plateau. These territories include Kenya Colony and Protectorate, Tanganyika Territory, and Uganda Protectorate. The fourth division of British East Africa is the protectorate which includes the islands of Zanzibar and Pemba. This article deals primarily with Tanganyika and Uganda. (*See also* Kenya; Zanzibar.)



East Africa is a huge plateau. The average elevation is about 4,000 feet. From the flat surface of the plateau rise a few lonely mountain peaks. The two highest peaks are Mount Kilimanjaro (19,319 feet) and Mount Kenya (17,040 feet). In the west the plateau is split into a great rift valley. In the rift are Lakes Victoria, Nyasa, and Tanganyika (*see* Africa, subhead "The Great Rift Valley").

Most of East Africa is on or close to the equator, but the climate ranges from semitropical to temperate because the land is high. Only in the low, swampy coastal regions is there excessive dampness and heat.

Tanganyika

The territory of Tanganyika was once German East Africa. It was conquered by Great Britain and Belgium in World War I. After the war, except for Ruanda-Urundi, which went to the Belgian Congo, Tanganyika was given to Britain as a League of Nations mandate. After World War II it became a British trusteeship under the United Nations.

Tanganyika is bordered on the north by Kenya and Uganda, on the west by Ruanda-Urundi and the Belgian Congo, and on the south by the Federation of Rhodesia and Nyasaland and by Mozambique. Off the Indian Ocean coast are the islands of Zanzibar and Pemba.

The territory of Tanganyika is larger than Alaska and has more than 500 miles of coast line. Dar es Salaam is the capital and chief port. Most of the trade in Tanganyika is carried on by Asian Indian merchants.

The greater part of the interior is too dry for farming. The semiarid grasslands, however, provide excellent pastures for great herds of cattle, sheep, and goats, owned mostly by African tribes. Sisal is the principal export. The British government tried to establish huge peanut (groundnut) plantations after World War II, but the effort was a dismal failure. The vast farms were then divided to be used for other crops. Cotton, coffee, pyrethrum, copra, beeswax, and mangrove bark are other important products. Mineral exports include diamonds, gold, tin, and silver. One of the richest diamond fields in Africa lies south of Lake Victoria. It was discovered by a Canadian after World War II. The territory is

administered by a governor appointed by the British Crown and by an executive council (Area 360 000 square miles population 1948 census 7 408 096)

Uganda

The protectorate of Uganda is bordered on the north by the Sudan on the west by the Belgian Congo and Ruanda Urundi and on the east by Kenya Uganda has a British governor but the African chiefs and kings are allowed considerable authority Unlike Kenya Uganda is a black man s country (*see* Kenya)

Land may not be sold to non natives except by special permission of the governor and this is rarely granted The highly intelligent Baganda are the leaders among the African peoples Their kingdom is called Buganda and their language Luganda Luganda is used in the schools which are maintained partly by missionary societies and partly by the British government (for picture of a mission school *see* Africa)

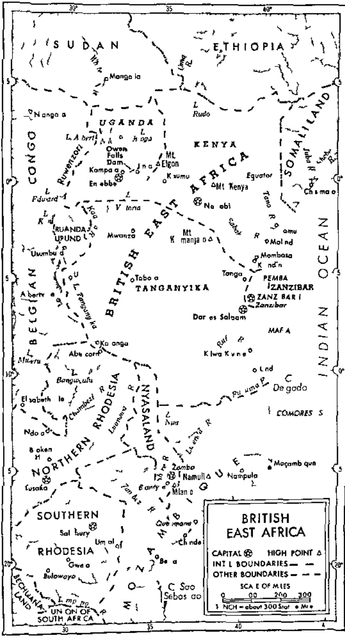
The government of Buganda is patterned after the parliamentary system of Great Britain The king is called the Kabaka The present Kabaka was educated at Cambridge England

There is a University College at Kampala capital of Buganda for the higher education of the Africans Kampala is linked by rail with the Kenya port of Mombasa There are branch railroad lines to the important cotton producing centers There is also steamer service on Lake Victoria

Uganda is the chief cotton producing country in British East Africa Almost all the cotton is grown by Africans without the supervision of Europeans The cotton is then exported mostly to India by Indian merchants who carry on most of the trade in Uganda as they do in Tanganyika

For food the Baganda and other tribes depend largely on bananas and millet These grassland tribes also raise cattle sheep and goats (For pictures in color *see* Africa)

In 1954 Queen Elizabeth II of Great Britain on one stage of her world tour opened the great new dam at Owen Falls The dam controls the flow of water from Lake Victoria through the Victoria Nile and eventually into the White Nile It is one of the largest hydroelectric developments in Africa and will furnish electric power to advance the industrial growth of East Africa Entebbe Uganda s capital on the north west shore of Lake Victoria has an international air



British East Africa has four political divisions Kenya Colony and Protectorate Tanganyika Territory Uganda Protectorate protectorate of Zanzibar and Pemba.

port. (Area of Uganda, 94,000 square miles; population, 1948 census, 4,962,749.)

History

East Africa was explored by Portuguese mariners in the 15th century. Later the land fell under Arab control. There was trade in both slaves and ivory. Germany became dominant in the 19th century, and the territory was called German East Africa. After World War I most of East Africa had become part of the British Empire. (For Reference-Outline and Bibliography, *see* Africa.)

EASTER. The greatest festival of the Christian church commemorates the Resurrection of Jesus Christ. It is a movable feast; that is, it is not always held on the same date. The church council of Nicaea (A.D. 325) decided that Easter should be celebrated on the first Sunday after the first full moon on or after the vernal equinox (March 21). Easter can come as early as March 22 or as late as April 25

In many churches, Easter is preceded by a season of prayer and fasting, called Lent. This is observed in memory of the 40 days' fast of Christ in the desert. In the Western church the Lenten season is from Ash Wednesday until the noon of Holy Saturday—the day before Easter These six weeks and four days include 40 fasting days, since Sundays are not fast days In the Eastern churches, Lent extends over eight weeks, and they do not observe Saturdays as fast days.

Ash Wednesday gets its name from the practice, mainly in the Roman Catholic church, of putting ashes on the foreheads of the faithful. This is to remind them that "man is but dust" and that he must do penance. The second Sunday before Easter is *Passion Sunday*. The week following is now usually called *Passion Week*, although Passion Week originally meant the week before Easter. *Palm Sunday*, one week before Easter, celebrates the triumphant entry of Christ into Jerusalem. Many churches are decorated with palms, and in some churches palms are blessed and distributed. *Holy Week* begins on this day. *Holy Thursday*, or *Maundy Thursday*, is in memory of the Last Supper of Christ with his disciples. *Good Friday* commemorates the Crucifixion.

The Easter service is the most elaborate of the church year. The message "The Lord is risen" is expressed in ceremonies, prayer, and music. Besides the services in churches, sunrise services are held outdoors in many places. Some, such as those at Pikes Peak in Colorado, in the Grand Canyon of Arizona, and in the Hollywood Bowl, have won national fame because of the beauty of their surroundings.

Many Easter customs come from the Old World. The white lily, the symbol of the Resurrection, is the special Easter flower. Colored eggs and rabbits have come from pagan antiquity as symbols of new life. The Easter Monday egg rolling on the lawn of the White House—a custom of European origin—is said to have been introduced in Washington by Dolly Madison.

In many Catholic countries, Lent is preceded by a *carnival* season. The origin of the word "carnival" is disputed. Some think it is from the Latin *carne vale* meaning "flesh, farewell." Others hold that it is from the Italian *carne levare*, "to give up flesh (or meat) Whatever the origin, it is a time for fun and good eating. Elaborate pageants often close this season on *Shrove Tuesday*, the day before the beginning of Lent This day is also called by its French name, *Mardi Gras* (Fat Tuesday). The Mardi Gras celebrations of New Orleans and other cities are famous.

Our name Easter comes from *Eostre*, an ancient Anglo-Saxon goddess, originally of the dawn. In pagan times an annual spring festival was held in her honor Some Easter customs have come from this and other pre-Christian spring festivals. Others come from the Passover feast of the Jews, observed in memory of their deliverance from Egypt (*see* Passover). The word *paschal* ("pertaining to Easter") comes through Latin from the Hebrew name of the Passover. The French word for Easter, *Pâque*, has the same origin.

Easter and Ash Wednesday dates for the years 1956–1965 are as follows:

ASH WED.	EASTER	ASH WED.	EASTER
1956 Feb 15	April 1	1961 Feb 15	April 2
1957 March 6	April 21	1962 March 7	April 22
1958 Feb 19	April 6	1963 Feb. 27	April 14
1959 Feb 11	March 29	1964 Feb. 12	March 29
1960 March 2	April 17	1965 March 3	April 18

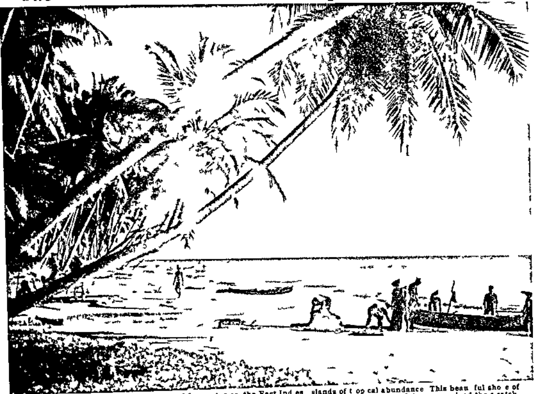
EASTER ISLAND. Far out in the South Pacific, about 2,200 miles west of Chile, lies Easter Island one of the loneliest islands in the world. Its nearest inhabited neighbor is Pitcairn Island, 1,300 miles away. The population of 563 (1940 census) is the remnant of a numerous people who were once skilled workers in stone and wood and had a form of writing different from any other one known.

Scattered over this volcanic island of about 50 square miles are many gigantic statues, each carved out of a single block of soft stone. Some are more than 30 feet high. Many have been transported several miles from the quarry in which they were carved and set up on great stone foundations. Why were these huge figures carved and how were they moved? No one knows. The present inhabitants have no traditions that explain this, and the old picture writing has not been deciphered. (For picture, *see* Pacific Ocean.)

The people who carved the immense statues, built the great stone houses, and cut records on wooden tablets evidently had a comparatively advanced civilization. The decline of this civilization has been explained as the result of wars, diseases brought by whalers early in the 19th century, and the transportation of most of the inhabitants to work the Peruvian guano fields about 1860. A few survivors were later returned to the island and converted to Christianity

The island, called Rapa Nui by the inhabitants, was named Easter Island by a Dutch navigator, Jacob Roggeveen, who discovered it on Easter Day, 1722 Chile annexed it in 1888 and made it into a national park in 1935. Most of the land is used for grazing sheep

The "SPICE ISLANDS"—*Their People and* TREASURES



Here is the land of which men dreamed for centuries the East Indies islands of tropical abundance This beautiful shore of Nias near Sumatra is typical of the low lying coasts where palms crowd down to the sea and fishermen unload their catch

THE East Indies is the world's largest group of islands There are thousands of them scattered along the Equator between southeast Asia and Australia They range in size from Borneo and New Guinea which are each larger than Texas down to mud flats of an acre or two

All told they cover more than a million square miles —one-third as much as the United States They have about 100 million people— mostly brown and black—with only two or three hundred thousand white people These tropical islands supply nine-tenths of the world's natural quinine one-third of its natural rubber and a large share of its kapok palm oil sisal tin tea and spices

The Indies hold a unique place in history Reports of their riches drew Europe into the Golden Age of Discovery Conquered by Europeans the Indies became a gateway for penetrating Asia For over three centuries most of the Indies belonged to the Dutch But after revolts in 1945 49 the Dutch freed them They became the United States of Indonesia but changed to the Republic of Indonesia in 1950 The Republic is in a Union with the Netherlands

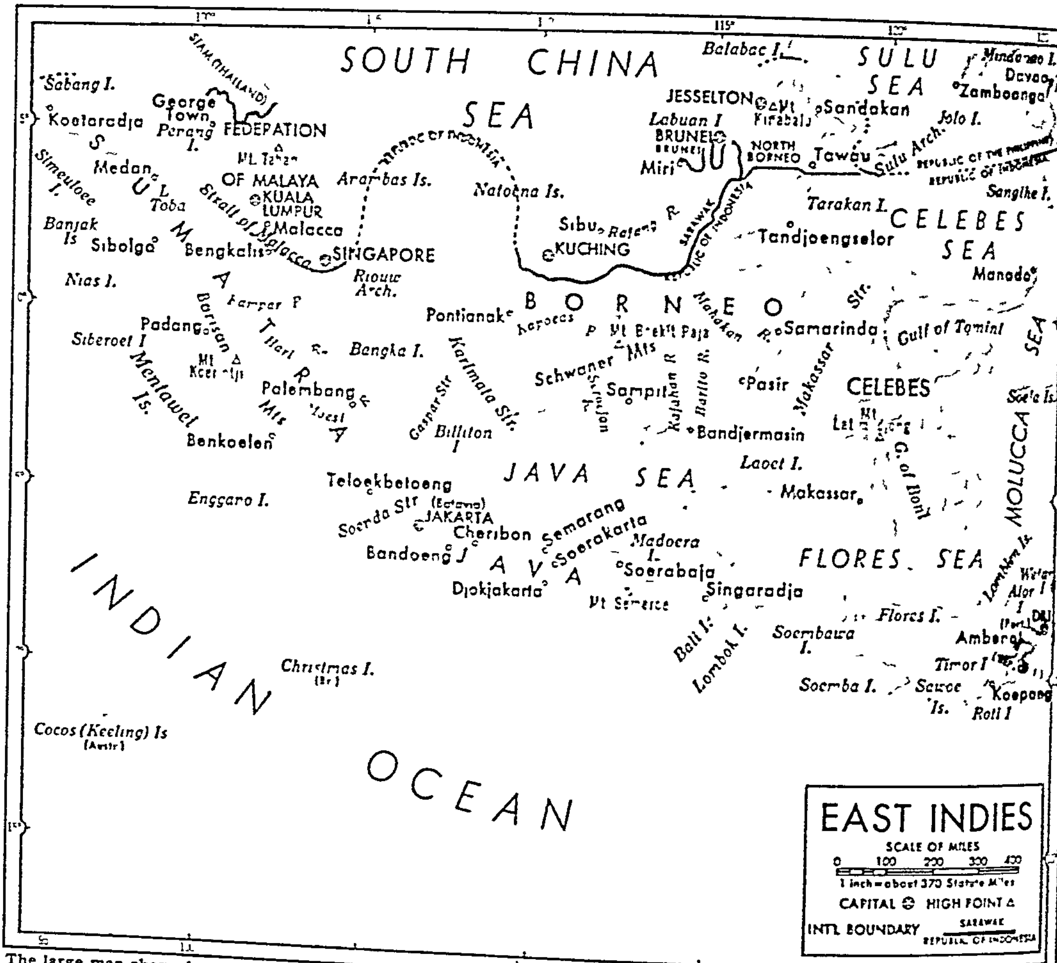
Britain holds part of Borneo and of New Guinea Portugal half of Timor The Philippines won freedom in 1946

EAST INDIES For centuries medieval Europe was fascinated by tales about the Spice Islands It was from this distant unknown region that spices came Spices were enormously important in the diet of the Middle Ages and sold for high prices After the Crusades the spice trade became one of the most profitable branches of commerce and Europeans longed to trade directly with the islands (*See* Spices)

In 1488 joy bells rang in Portugal when Bartholomew Diaz returned from finding the beginning of a sea route around Africa to these fabled lands Four years later Columbus rejoiced to think—though he was wrong—that he had found a westward route to them Thirty years after Columbus first voyage Magellan did find this route and one of his ships sailed around the world for the first time in history (*see* Magellan)

Thus the Spice Islands were one of the magnets which drew Europe on to its Golden Age of Discovery For the next four centuries the seafaring nations of Europe often fought for these rich islands which came to be known as the East Indies By the 19th century the Netherlands held most of them and a few million Dutch people in Europe kept millions of natives pouring out tropical products and minerals

But some nations looked enviously at so little a country holding so great a prize Japan in particular was jealous It lacked resources at home and these islands could supply its need for petroleum



The large map shows how the islands of the East Indies lie like necklaces of beads between the Pacific and Indian oceans. One chain runs from Borneo through Celebes to New Guinea; another runs from Sumatra through Java to Timor.

rice, cotton, rubber, and metals. So they were seized at the very outset of Japan's entry into the second World War, and held until the defeat of 1945.

Extent of the Islands and How They Were Made

These thousands of rich and trouble-breeding islands are called either the East Indies or the Malay Archipelago. Another name, used by many Dutch writers, is Indonesia. They stretch along both sides of the Equator for a total span of about 3,800 statute miles —more than the distance from New York to Cadiz, Spain. From Manila in the Philippines to Batavia in Java is almost as far as from New York to Yucatan. Some of them are huge. New Guinea and Borneo are both larger than Texas; Sumatra is larger than California; Luzon and Mindanao in the Philippines are both larger than Indiana; and Java is about the size of Louisiana. Hundreds of smaller islands lie in festoons between these big ones.

Some geologists believe that an almost empty sea once separated Asia and Australia. But in a recent age southeast Asia moved or swelled toward the Pacific Ocean, with the basin of the South China Sea leading the movement. This threw the ocean floor up in ridges around the edges of the moving mass, and the tops of these ridges rose above the sea as islands.

Along these ridges the earth's crust weakened and let molten rock well up from below. This made a line of volcanoes through Sumatra and Java to Timor, then north to the Philippines; another line rose in New Guinea. Many of these volcanoes are still active, and earthquakes occur frequently.

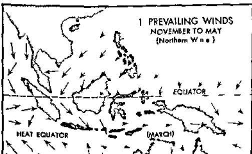
Hot Climate and Luxuriant Plant Life

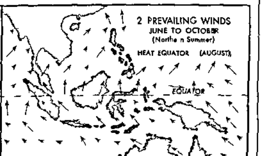
Since the islands lie in the ocean along the Equator, the general climate is hot and wet, with frequent thundershowers. The rainfall, between 100 and 150 inches a year in most places, favors growth of dense forests. At sea level, the mean temperature ranges between 80° and 90° F., and it varies only a few degrees throughout the year. But most of the islands are mountainous, and the climate becomes subtropical at about a third of a mile above sea level. The higher peaks rise above 10,000 feet and have a cool climate. Some in New Guinea have perpetual snow. Monsoon winds and the mountains together cause wet and dry

Since the East Indies are located near the Equator in a vast expanse of sea the climate is basically of the marine equatorial or doldrum type with light winds and frequent thundershowers These are most intense in the zone of greatest heat (the heat equator) which shifts north and south with the seasons But this general climate is modified by seasonal monsoon winds from Asia and by the effect of mountain ranges

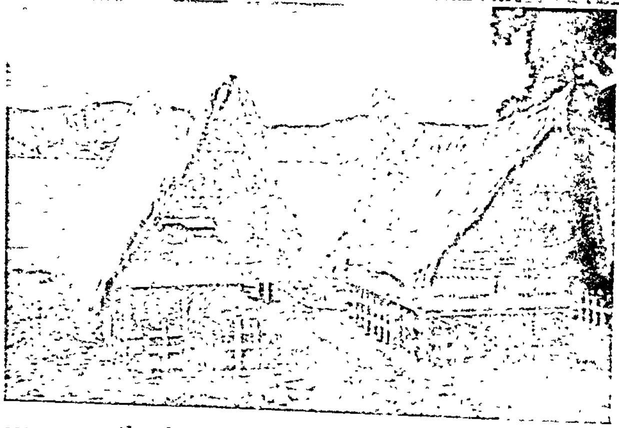
From November until May the winter monsoon blows outward from Siberia over the Pacific Ocean During this movement it curves toward the west as is explained in the article on Winds By the time it approaches the Equator and the East Indies it is blowing from the northeast as shown in Map 1 It also has picked up moisture from the China Sea and it drops this as rain on the north and northeast slopes of the mountain ranges The sheltered sides have a dry season

From June until October when the interior of Asia is hot the summer monsoon blows from the south or southeast toward Siberia as shown in Map 2 Then the south and southeast sides of the mountains get rain from Sumatra to central Java, East of here however the wind has come from Australia and it has little moisture Hence from central Java through New Guinea the season is dry





PART OF THE MOUNTAINOUS BACKBONE OF THE EAST INDIES



Sumatra's highlands (above), seen across Lake Toba (3,000 feet), are typical of the mountainous interiors of the East Indies. Erosion of volcanic cones like this produces rich soil. Here it is worked by Bataks, an industrious hill people. Their houses (left) are thickly thatched against the heavy rains.

seasons, as the sketches on page 203 show. The dry season, from June to October, is particularly marked on all southern slopes from central Java eastward.

As the traveler approaches a typical island, it looks like a tropical fairyland. From a low swampy or sandy shoreline the land rises sharply to a purplish peak or range of mountains in the background. The forest starts almost at the water's edge. Teak, ironwood, ebony, and other valuable timber trees are mingled with palms—hundreds of kinds of them. The most useful are the coco, the sago, the nipa, and the vinelike rattan (*see* Palm). Bamboo grows in dense thickets. Huge ferns and brilliant flowers are everywhere.

These equatorial forests extend from Sumatra across Borneo and western Java. Farther east, where pronounced dry seasons occur, the forest is replaced by savanna or grassy jungle, dotted with thorn bushes, bamboo, and stunted eucalyptus trees. But here too forests grow in the swampy deltas of many rivers. On the higher, cooler mountain ranges grow azalea, rhododendron, oak, laurel, maple, and some pine.

Animals and Wallace's Line

The animal life of the islands shows a striking regional division along Wallace's Line. This name comes from the naturalist Alfred Russel Wallace, who announced his discovery of this division in 1869.

Wallace's theory begins with the fact that the sea is not 300 feet deep over the whole stretch between the Malay Peninsula, Borneo, Sumatra, and the island of Bali, just east of Java (*see* map). This suggests that in the past all this western division was one land. The animal life bears this theory out. Asiatic animals such as tigers and rhinoceroses, as well as many monkeys, apes, and birds, are found throughout this division. But the animals of all the islands east of Borneo and Bali are like those of Australia. This fits the belief that these eastern islands once were linked with Australia and got their animal life from that continent. Wallace concluded that the line separating these two kinds of life in the East Indies begins between Bali and Lombok and runs northward between Borneo and Celebes. (*See also* Australia.)

How the People Live

The people too differ east and west of this line. West of the line the islands are inhabited mainly by Malays, a short, brown-skinned people akin to the southern Chinese (*see* Malay Peninsula). These people are skilled boatmen, farmers, and metal workers. The mountain Malays, called Dyaks in Sumatra and Borneo, and Igorots in the Philippines, are less advanced than the lowland Malays.

East of the line, the natives are mostly Negroes and Negritos, of the Papuan and Melanesian groups. They live largely by gathering wild food and by fishing. These people are supposed once to have occupied all the islands before the Malays came from Asia and

eized the best regions On the western is-
ands, Negritos now live only in the remote
nountain regions (See Pacific Ocean)

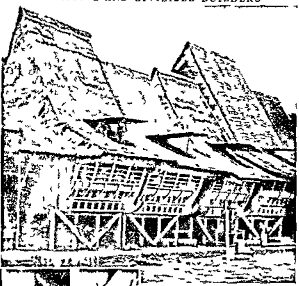
All these people have much the same ways of ife Their villages are usually in a clearing on a river The houses are set on piles and occa sionally in trees, to be above the wet earth They have floors of split bamboo and roofs thatched with nipa palm leaves Some walls are thatched, others are merely mats hung between uprights

For food, the people fish in the river or the sea and gather fruit in the forest The more advanced Malays also grow rice often in ter races built along mountainsides Common vegetable crops are millet corn, cucumbers and peppers The favorite food animals are chickens and pigs There are cattle for work and food, but the natives do not use milk

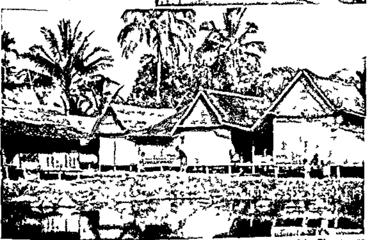
For clothing, Negritos wear a grass or palm leaf skirt, or perhaps just a loin cloth Malays wear a shirt, a turban, and a sarong—a square of colored cloth draped to form a skirt

Except for the Christians in the Philippines most of the Malays are Mohammedans The hill Malays, or Dyaks and the Negritos believe in spirits and ghosts, and practise magic They used to preserve the heads of their enemies because they believed that this enslaved the spirit of the dead man They also buried an enemy s head with a dead chief or under a new house Head hunting is forbidden now, but the Dutch government let some tribes retain old heads In Borneo the government even kept a few to lend to villages for magic tribal ceremonies

PRIMITIVE AND CIVILIZED BUILDERS



Most primitive tribes in the Indies are content with thatched huts But the people of Nias show unusual architectural skill and build apartment houses (top) supported by massive logs (center) Open walls and skylights give light and air



The Javanese most advanced of the East Indians use light weight materials They weave split bamboo for the walls and palm leaf thatch for roofs But they follow the cottage style of white men. Throughout the Indies, houses are raised to escape the wash of heavy rains

Wherever white influence is strong, the native ways of life have been greatly changed In Java almost half of the land has been cleared, and the countryside has been as nearly Europeanized as a tropical land could be (see Java) Elsewhere, such changes rarely extend far from the seaports

The Riches of the Indies

The Indies total over a million square miles and have a population of about 100 million people The Netherlands won the lion's share of this immense territory The only exceptions were the Philippines the British parts of Borneo and New Guinea with the adjacent islands and the Portuguese half of the little island of Timor (See Borneo New Guinea, Philippine Islands)

The former Dutch region (now Indonesia) has rich nat-

ural resources, and supports a native population of about 80 million. The native people are called *Indonesians.* Europeans total only some 240,000 and include Eurasians—people of mixed white and Asiatic blood. There are more than a million Chinese and a few Hindus, Japanese, and Arabs. Although the Dutch owned the Indies for over three centuries, they are still only a tiny fraction of the population. But they developed the Indies, and they still have enormous holdings.

Originally a source only of luxuries, such as rare woods and spices, the East Indies came to supply raw materials for many of the world's daily modern needs. These tropical islands usually produce about a third of the world's natural rubber; about a fifth of its tin, agave and sisal fiber, and palm-oil products; three-fourths of the kapok; considerable quantities of tea, coffee, and sugar; and almost all of the world's supply of pepper and quinine.

Another useful gift is petroleum. The East Indies normally rank fifth in world oil supply. The output is only about 3 per cent of the world total, but scarcity of oil fields in East Asia makes Indies petroleum immensely important throughout this part of the world.

In normal times the East Indies supply about 2 per cent of the world's export trade. The Netherlands, the United States, the British Empire, and Japan take most of the exports. The United States normally gets from the Indies about a fifth of its rubber, half of its palm oil, a third of its sisal, and a tenth of its tin. The Indies take their imports mostly from the same countries. These include rice, iron and steel, machinery, cotton goods, chemicals, and a wide variety of other manufactured goods.

AGRICULTURE AT DIFFERENT ALTITUDES

Different altitude levels favor a variety of crops. Irrigated fields in the warm lowlands grow rice. Here it is being transplanted from thick seed beds. As the land rises, you find *ceiba* trees. Their kapok fiber (center) is an important cash crop, especially in Java and Celebes. The warm moist highlands (1,500 to 3,500 feet) of Java and Sumatra grow tea for export (top). These Javanese are setting out plants in the rich volcanic soil.

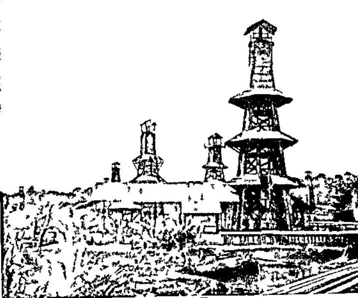
Farms and Crops

Most of the exports, as well as the means of living for about 70 per cent of the inhabitants of the East Indies, come from agriculture. Until the 20th century, the natives grew crops only for themselves, and export crops were produced on "estates." These are large tracts which European and Chinese owners lease from the government or from native rulers.

This system produced large profits and paid taxes enough to meet almost all cost of government. It also made it easy to introduce scientific methods and profitable new crops. Tea growing started early in the 19th century, and now Indonesian plantations usually export more tea than China or Japan. Cinchona trees, brought from South America, now produce most of the world's quinine. Rubber is an important product of Sumatra, Borneo, and Java. The palm-oil tree, brought from equatorial Africa, has made the Indies the leading source of palm oil used in soaps and margarine.

But the estate system employed only about a tenth of the farm workers. It kept the native standard of living low, because independent farmers could not produce for export in competition with the estates. These evils became critical early in the 20th century, when Java's population exceeded food production. The Dutch régime then provided credit, irrigation, and other aid for small operators, and promoted immigration to

THREE IMPORTANT PRODUCTS USED THROUGHOUT THE WORLD



Bark stripped from cinchona trees on the highlands of Java and Sumatra (extreme left) supplies nearly all the world's quinine. Oil fields like this on Tarakan Island (above) make the Indies a leading producer of petroleum. The islands are also a major source of rubber. At the left, one of the many Malay workers on the rubber estates is gathering latex.

the Outer Islands, as the Dutch called all the East Indies except Java and Madoera. There the people obtained land and soon were growing more than half of the exported crops.

Wealth from Forests, Minerals, and Industry

Forests still cover about one fifth of Java and more than two-thirds of the land elsewhere. Exported forest products include rattan, resins, camphor, and tanning barks. The most valuable minerals are tin and petroleum. The tin is on the islands of Bangka, Billiton, and Singkep near Sumatra (*see* Tin). Petroleum production began in eastern Java and Madoera, but a larger output has come from Sumatra, the Molucca Islands, and Borneo, with its adjoining islet Tarakan. Sumatra and Borneo yield small amounts of coal, gold, and silver. Some bauxite, manganese ore, asphalt, and phosphates are also mined.

When export crops fell in the world depression of 1930–39, the Dutch government promoted industries for processing raw materials such as petroleum, tin, sugar, and palm oil. It encouraged the native industries such as woodworking and making batik, leather, pottery, and hats. Natives were also trained for factory and shipyard work.

The government also spent large sums on vocational training and village schools. Its public health program reduced malaria and bubonic plague, and it put villages as well as cities under strict sanitary rule in all the well-settled regions.

Sea Lanes, Air Lines, and Railroads

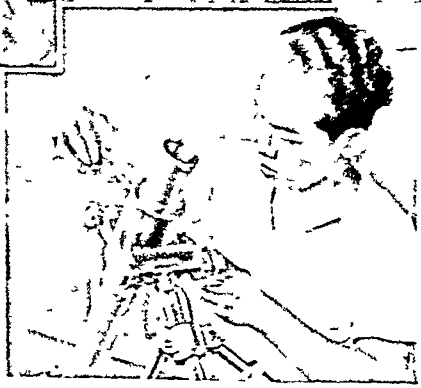
Today, just as centuries ago, the islands rely largely upon water transportation. An extensive system of air lines also serves the islands and provides connections with Australia, Asia, and Europe. The air link with the home land flies 11,000 miles.

Little need has been felt for railroads. Java has about 4,000 miles; the few other lines feed seaports in Sumatra. Most of the 43,000 miles of improved roads are in Java and Sumatra.

The Long and Troubled History of the Indies

The Malays, who are the most numerous of the inhabitants, spread over the islands in several waves. Hindus from India also set up states in Java and

OLD ARTISTRY AND MODERN SKILLS



The Malays have a rich heritage of Hindu arts and crafts. A Balinese sculptor (top, left) works on an ornate temple god. The poised, graceful girl reflects the training of Balinese dancers. A turbaned wood carver (right) instructs his son. All wear beautiful batik sarongs. The young Javanese (left) turns his manual skill to machine work.

Sumatra, perhaps as early as the first century after Christ These states were destroyed after the 12th century by a fresh wave of Malay invaders, who had been converted to Mohammedanism. Only the ruined temples and sculptures of Java and Sumatra remain as memorials of Hindu rule.

Before the Christian era the spices and other rare goods of the Indies were finding their way to Europe. The Portuguese visited the Moluccas in 1511, and soon after established a capital at Ternate, in the heart of the spice trade. They made shipments to Lisbon, and let the Dutch, then under the rule of Spain, distribute the merchandise throughout Europe.

Spain gained complete control of this trade when Philip II assumed the Portuguese crown in 1580. Next year, when the Dutch revolted, Philip barred them from the Indies. But after the defeat of the Spanish Armada in 1588, the Dutch, knowing that Spanish power in the Indies was weak, set out to seize the region. Their first expedition was in 1595–97, and the venture was organized in 1602 as the United East Indies Company.

In 1611, they established a capital in Java at Jakatra (renamed Batavia in 1619). Within half a century they ousted the Portuguese from all but a last foothold on Timor. Spain, however, retained the Philippines (see Philippine Islands). Occasional wars were fought between the Dutch and the English until 1811, when the English seized all the East Indies as a countermeasure to Napoleon's annexation of Holland to France. After the fall of Napoleon, the Dutch agreed to British dominance in Malaya and the British gave back the islands in 1816.

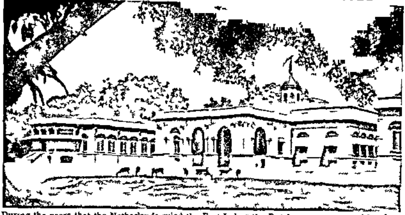
Thereafter the Dutch rule was generally peaceful except for wars with Javanese sultans (1825–30) and with various Sumatran tribes. These tribes were not finally subdued until early in the 20th century.

During the struggles with the English the East Indies Company proved unable to cope with its problems, and the Netherlands govern-

WHERE THE EAST LEARNS WESTERN WAYS

These sturdy, neatly dressed Sumatran boys and girls show the influence of their Dutch schooling. The Dutch schools aimed to raise the health standards of the natives and to train them for modern industry. Indonesian nationalists planned to extend the Dutch system.

HISTORIC RELIC OF DUTCH COLONIAL RULE



During the years that the Netherlands ruled the East Indies the Dutch governor general lived in this spacious residence at Buitenzorg about 35 miles south of Batavia (now Jakarta) The residence is surrounded by world famous botanical gardens Notice the deer grazing on the wide lawn

ment revoked its charter in 1798 The new administration continued to exploit the Indies until exposure of abuses roused public opinion in the Netherlands and led to the beginnings of an enlightened and progressive colonial policy in 1854 *This policy kept* the estates system somewhat but widened educational and economic opportunities for the Indonesians and improved health conditions and living standards

Early in the 20th century in 1916 the Netherlands gave the Indies a measure of self rule The colonial government established a partly elective Indonesian parliament (*Volksraad*) which opened in 1918 It shared responsibility with the governor general appointed by the Dutch crown Many local matters were entrusted to *dessas* or village communities Princes or sultans advised by Dutch officials ruled the Native States Similar rule extended over a small part of Java and over most of the Outer Islands

Indonesia Wins Independence

Through the 1930s the chief problem of the Dutch was Japan s ambition to gain control of southeast Asia *The Dutch hastily strengthened the Indies de*fenses but Japan overwhelmed the islands in 1942 soon after fighting started in the Pacific (*see* World War Second) When Japan surrendered (1945) Indonesian nationalists demanded immediate independence They fought against the British who came to liberate the islands from the Japanese and restore order then against the Dutch when they returned to set up again the Netherlands rule

The fighting ended temporarily in 1946 when the Indonesians and Dutch signed an agreement providing for a gradual transition from colonial status to self government Under this agreement the Netherlands recognized the Indonesian Republic (consisting of Java Sumatra and Madoera) The agreement also provided for establishing by Jan 1 1949 a United States of Indonesia which would join the Netherlands in a Netherlands Indonesian Union

The Dutch claimed however that the Indonesian Republic did not restore order and in 1947 they seized key areas A truce fixed by the United Nations failed The United Nations then censured the Dutch for repressing Indonesian trade In 1949 both sides obeyed a cease-fire order by the United Nations and arranged freedom for Indonesia

The new nation the United States of Indonesia was created Dec 27 1949 It was made up of 16 former provinces but the federation was loose and unwieldy On Aug 17 1950 it adopted a central government and became the Republic of Indonesia with Jakarta Java as capital In 1954 the republic broke its last link with the Netherlands withdrawing from an autonomous union (For history of the republic *see* Indonesia)

EBONY The saying black as ebony suggests one reason why this wood is used for piano keys inlaying cabinetwork and knife handles Cabinetmakers value it for its jet-black color and ability to take a high polish

Ebony wood is obtained from about 15 species of tropical and semitropical trees which grow in the East Indies India and Africa Ceylon and southern India are the leading producers of the true ebony of jet-black color Only the heartwood of the true ebony is used because the sapwood is white Some species yield a brown wood rather than a black One species the persimmon grows in the United States from *Connecticut to eastern Texas (see Persimmon)*

Most commercially important ebony trees belong to the genus *Diospyros* of the family *Ebenaceae* Chief among them are *Diospyros ebenum* of southern India and Ceylon and *Diospyros melanoxylon* of the East Indies which yields Macassar or Coromandel ebony

ECHO *According to an old Greek myth a beautiful* nymph named Echo fell in love with Narcissus but he did not love her She pined away until her voice *had only strength enough to whisper the last word* of any call she heard

This was the poetical Greek explanation of an echo The scientific *explanation is that sound waves are* reflected from flat surfaces An irregular surface breaks up the waves just as a rocky shore breaks water waves into spray A smooth surface such as the side of a cliff reflects sound waves and we hear the reflection as an *echo*

Because the *reflected waves have lost strength* they cannot be heard until the original sound has ceased If you are about a hundred feet from the reflecting surface you hear only the final syllable of

AND ECHO ANSWERS "YOU"

The Greeks had a myth that echoes were the voice of a nymph who had pined away from hopeless love until only her voice remained. She was supposed to haunt the woods and rocks and repeat the last syllable of any cry she heard. Above is the head of a beautiful statue by the sculptor Hertig, representing Echo Listening for a call.

what you call. If you take your stand farther back, more and more syllables can be heard.

Sir Isaac Newton used the echo in a corridor at Trinity College, Cambridge, to measure the speed at which sound travels. Standing at one end of the corridor he started a group of sound waves by stamping his foot. These waves were thrown back by the wall at the far end of the corridor. He timed the interval between stamping his foot and hearing the echo. He knew the distance to the wall and back; and from these factors he calculated a speed for sound which was within a few feet a second of the speed which modern science has determined (see Sound).

ECLIPSE. The primitive Norsemen thought the sun and moon were pursued by two enormous wolves, who now and then very nearly succeeded in devouring our chief sources of light. Even till recent days the Chinese believed a solar eclipse was caused by a great dragon attempting to swallow the sun. On such occasions they would go out into the streets and set up a terrific din to frighten the monster away.

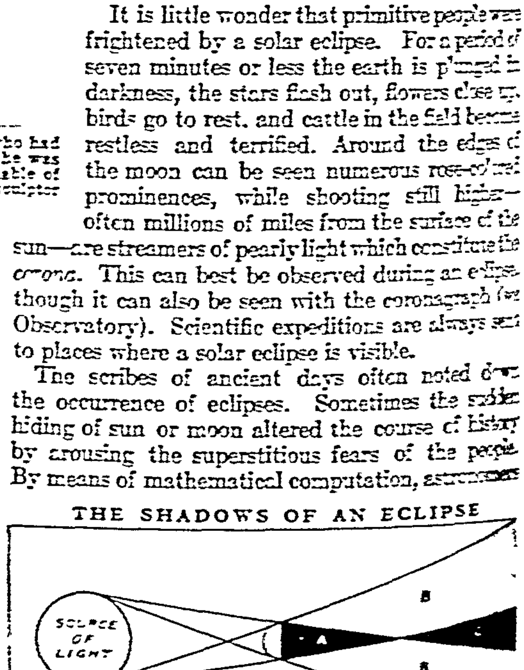
The facts are not so romantic, though it would be near the truth to say the sun and moon and earth are playing hide and seek with one another. A solar eclipse occurs when the moon gets between the sun and earth, obscuring the sun from our view. A lunar eclipse, on the other hand, is caused by the shadow which the earth casts on the moon when the earth is between the moon and the sun.

Imagine a straight line drawn through the sun and earth and extending beyond the earth on the other side. If the moon in its monthly trip around our planet always passed directly through this line, first on one side of the earth and then on the other, we should see two eclipses every month—one of the sun and one of the moon. But the moon moves in an orbit which is tilted somewhat away from the orbit made by the earth in its annual journey around the sun, and for that reason eclipses are comparatively rare. There may be as many as four of the sun and two of the moon in a year, or there may be no eclipses of the moon and only two of the sun. In many cases, of course, these eclipses are only partial, and from a single spot on the earth it is not likely that a total solar eclipse will be observed more than once in 300 years. An "annular" eclipse is one in which a considerable rim of the sun is still visible around the edge of the moon; it occurs when the moon is farthest from the earth.

It is little wonder that primitive people were frightened by a solar eclipse. For a period of seven minutes or less the earth is plunged in darkness, the stars flash out, flowers close up, birds go to rest, and cattle in the field become restless and terrified. Around the edges of the moon can be seen numerous rose-colored prominences, while shooting still higher—often millions of miles from the surface of the sun—are streamers of pearly light which constitute the *corona*. This can best be observed during an eclipse, though it can also be seen with the coronagraph (see Observatory). Scientific expeditions are always sent to places where a solar eclipse is visible.

The scribes of ancient days often noted down the occurrence of eclipses. Sometimes the sudden hiding of sun or moon altered the course of history by arousing the superstitious fears of the people. By means of mathematical computation, astronomers

THE SHADOWS OF AN ECLIPSE

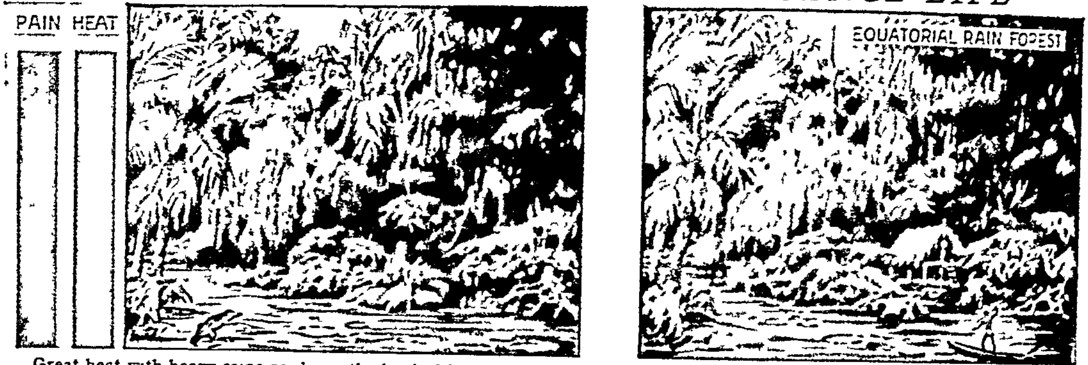


The black space lettered "A" is the region of total eclipse called the "umbra." The space marked "B" is the "penumbra," or region of partial eclipse, from which a crescent-shaped portion of the sun is seen. In the space "C" the sun is seen as a ring, with a dark spot made by the moon in the center.

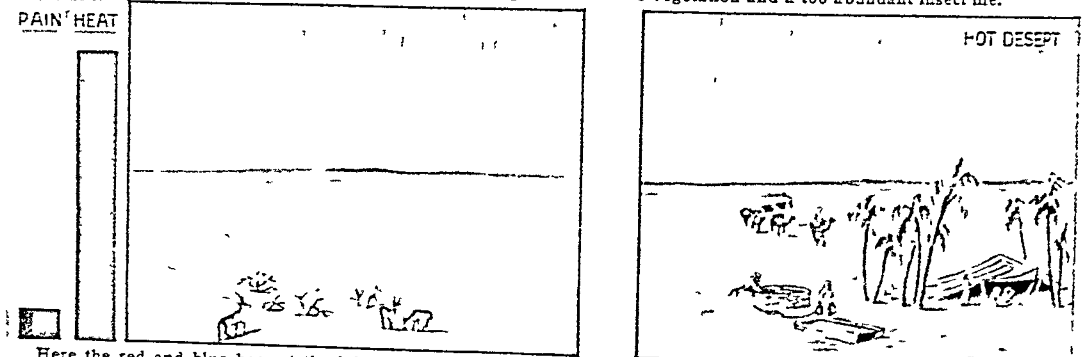
can now determine exactly when these events must have taken place. One celebrated example is mentioned by Herodotus, when the Medes and Lydians after fighting for five years, laid down their arms and made peace because of the occurrence of a solar eclipse just as they were about to go into battle. This date has been fixed as May 28, 585 B.C. Other planets besides the earth eclipse their satellites, and certain stars are sometimes darkened by companion bodies, but these phenomena are usually called "occultations."

At certain times the moon passes between the sun and earth and casts its shadow on the earth's surface. Such an event is a solar eclipse. Here it is seen as it might appear from a point many thousands of miles out in space. The dark inner shadow (umbra) strikes only one small area. But the thin outer shadow (penumbra) extends over a much larger area.

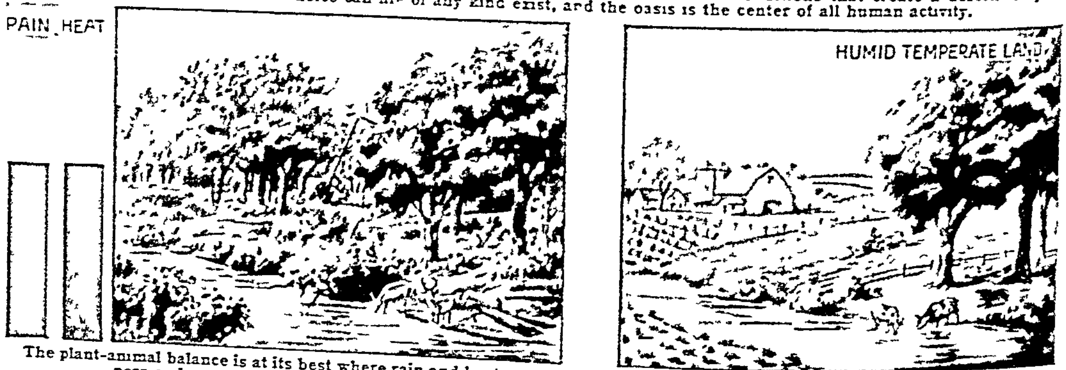
HOW HEAT AND MOISTURE INFLUENCE LIFE



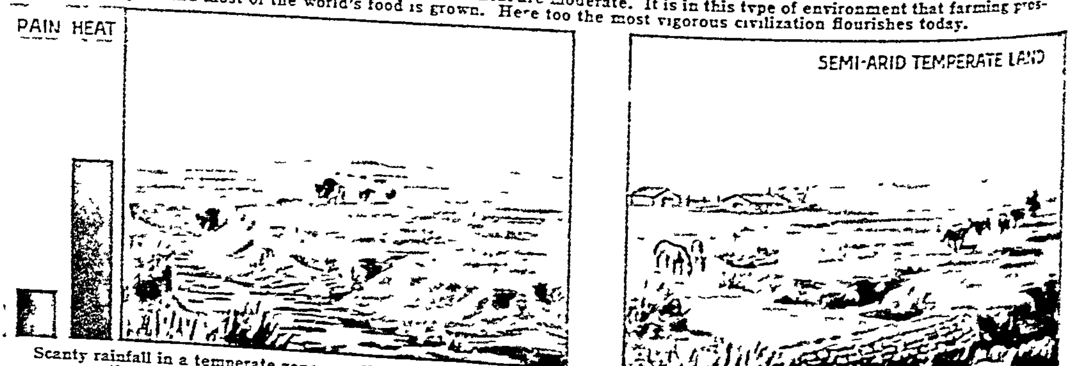
Great heat with heavy rains produces the kind of forest shown here At the right we see a primitive native settlement typical of this environment Here men must fight against excessive vegetation and a too abundant insect life.



Here the red and blue bars at the left show great heat with very little rain—the conditions that create a desert. Only around the rare water holes can life of any kind exist, and the oasis is the center of all human activity.



The plant-animal balance is at its best where rain and heat are moderate. It is in this type of environment that farming prospers and most of the world's food is grown. Here too the most vigorous civilization flourishes today.



Scanty rainfall in a temperate zone usually means treeless plains with meager water courses, like the old buffalo ranges of the West. These now support cattle and sheep but, without irrigation, farming is difficult or impossible.

ECOLOGY—*The Study of Community* RELATIONSHIPS *Among Plants, Animals, and Men*

THOUGH Ecology is one of the youngest of the sciences it is one of the most important for the future of mankind It studies the relations of living things to the world in which they live and tells us among other things how we can most effectively use and conserve our resources Many of the most pressing problems of today are ecological How can we make the best use of our land? How can we save our soil, our forests and our wild life? How can we reduce the great losses caused by harmful insects? These are samples of the practical questions the ecologist asks and tries to answer Few of us will become ecologists but we can all better understand the world we live in and better adjust ourselves to it if we know something about Ecology

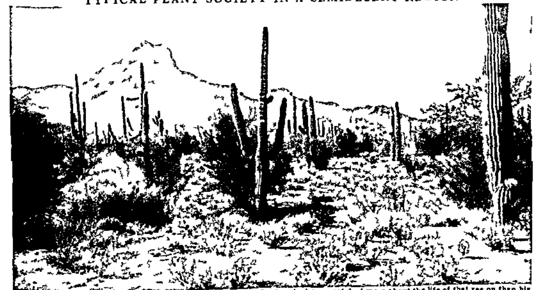
ECOLOGY (*ē kŏl ŏ-gĭ*) Few living things stand alone Where we find one kind of plant or animal we almost always see other kinds near by In deserts and in cold regions the number of different kinds existing together in one place may be small In more favorable regions thousands of species may dwell on a single acre But in every instance we can be sure that the plants and animals found together are not associated with one another by mere chance

We know first of all that each kind of life is suited to the physical conditions of the spot where it lives—the kind of soil the amount of moisture and light and the varying temperatures and seasons Second we know that each of them is living there because for the time being at least it is able to hold its own in its relations with its neighbors What we may not realize is that the continued existence of such a group or *life community* is a matter of delicate balance and of complicated adjustments among its members Some very slight change the removal of a single species from the group or the addition of a new species may have astonishing results

If you told a farmer for example that he could increase the red clover in his pasture by adding a number of domestic cats to his household he might not take your suggestion seriously Yet the relation between cats and red clover is clearly explained in Darwin's Origin of Species The cats will kill field mice This will save the lives of many bumblebees whose nests and grubs would otherwise be destroyed by the mice This in turn will mean that there will be more bumblebees at work fertilizing the clover blossoms—a task for which they alone are fitted And the more thoroughly the blossoms are fertilized the more seed will be produced and the richer will be the next clover crop

Ecology deals with plant and animal communities It treats of the relations of living things to the world in which they live that is to say their environment It investigates chains of cause and effect like the cat-mouse-bee-clover example given above It suggests ways in which we can read nature's secrets more intelligently and apply our knowledge to make the forces of nature serve us more effectively The name

TYPICAL PLANT SOCIETY IN A SEMIDESERT REGION



One glance at this picture made near Tucson Ariz tells the trained ecologist a great deal more about the life of that region than his eye can see The cactus plants and mesquite bushes show him that water is scarce He knows that the insects birds and four footed creatures found there will all be of the kind that require little moisture

of this branch of science is newer than the subject it covers. For men have always been concerned with the problem of life and environment.

I. THE NATURE AND PROBLEMS OF ECOLOGY

Even before the days of science, the wild hunter who knew that deer must come to the salt lick for salt was a practical ecologist. So was the fisherman who knew that a flock of gulls hovering over the water marked the position of a school of fish. So was the native doctor who sought for his herbs in the proper soil at the right time of year. Before the days of calendars men used ecological facts to guide their yearly round of work. They planted corn when oak leaves were the size of a squirrel's ear. And the noise of geese flying south was a warning to prepare for winter. The scientific study of such things was for a long time—until perhaps 1850—known as Natural History and the man who studied nature out-of-doors was called a naturalist. Meanwhile Natural History was being broken down into special fields, such as geology, geography, zoölogy, and botany, and the students moved indoors. They did their work in the laboratory with the aid of the microscope and other apparatus.

Some Questions Ecology Tries to Answer

But while scientists were busy in the workshop, other men were working out-of-doors with living things, in field, forest, stream, and ocean. Forester, rancher, farmer, gamekeeper, fisherman—all worked daily with living things. Often they found themselves asking help from science. But many of their questions could not be answered in the laboratory.

The forester, for example, wants to know why trees do not thrive on the prairie, the desert, the high mountain tops. He also wants to know why certain trees live together. Why is hickory usually found with oak, and beech with maple?

The rancher wants to know how to manage his pastures so his cattle will thrive. And he needs to know how such animals as coyotes, rabbits, hawks, and gophers affect his business. Almost every part of the farmer's work is a problem in ecology. The gamekeeper sooner or later finds out that his job means much more than keeping out one set of hunters so that another set can shoot the game. For game must have the right kind of food to eat in all seasons of the year, places to live and raise its young, and the kind of cover it is accustomed to.

INFLUENCE OF ALTITUDE ON VEGETATION AND POPULATION

The upper half of the pictograph on the opposite page shows the relation of altitude to vegetation in three different latitudes—in Mexico, in the French Alps, and in Iceland.

In the diagram representing Mexico, palms stand for tropical vegetation. Above them are shown hardwood trees, grain fields, and the semidesert vegetation that exists at those altitudes when the climate is too dry for trees or grain. Still higher are shown the evergreen trees, forming the timber line. Beyond them comes an area of scrub vegetation, and at the very top, above 15,000 feet, an entirely barren region commonly covered with eternal snows.

In the diagram of the French Alps the lower levels show hardwood trees, grain fields, cultivated pasture lands, and vineyards, with evergreens, scrub, and barren lands above. But notice how much less elevated are the vegetation belts than in Mexico. The evergreens, which in Mexico live at 12,000 feet, flourish at 5,000 feet in the Alps.

In the cold climate of Iceland the evergreens exist at sea level and the upper limit of scrub vegetation is 3 000 feet.

The lower half of the pictograph shows how the population is distributed in the three regions. Notice that in Mexico the densest population is found around 7,000 feet above sea level. If you have already discovered why, then you are a good amateur ecologist. Where is the center of the food-growing area of Mexico? Where is it in the French Alps? As for Iceland, it has no rich food-producing area. It supports about the same number of people to the square mile as do the tropical forests along the coast of Mexico.

The fisherman finds that most fish will not do well in muddy rivers, so he has to know why rivers become muddy and filthy. He becomes interested in the management of the landscape when he discovers that the troublesome mud comes from land where trees have been cut, or from cattle ranches that have been badly handled, or from farms that are running down.

If the fisherman lives near the ocean, he wants to know what makes the fish abundant in one place and scarce in another. He must know the feeding and breeding habits of the fish from which he makes his living, and of the smaller animals and plants upon which the larger fish must feed.

Wide Scope of This Young Science

All these are ecological problems. To answer them the ecologist must know something of a good many different sciences. He must understand biology, which is the science of living things, including botany (plants) and zoölogy (animals). He must understand the science of weather and climate; of rocks, earth, and soil; of water and its behavior.

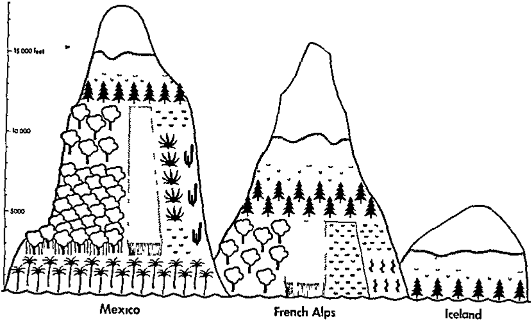
The word ecology was coined in 1886. It comes from the Greek word *oikos*, meaning "household." This is the same word from which economics takes its name; but economics deals with human business, while ecology deals with nature's housekeeping.

Ecology must look into the past and the future. The condition of a forest or a field today cannot be understood without knowing its earlier history. In traveling across the Rocky Mountains we often see great stretches of light-green aspen trees, while near-by mountains may be covered with dark-green fir and spruce trees. This shows that a forest fire destroyed the evergreens where the aspens stand today. The aspens are fire trees, coming in to heal ground scarred by fire. They are worthless for lumber. If we watch through the years, we find that young aspens do not come up in the shade of the old. Often, before the aspen trees are 40 years old, spruce and fir seeds begin to germinate in their shade, and in the course of time the evergreens regain their lost territory. This illustrates what is meant by saying that ecology is a way of looking backward and forward in time.

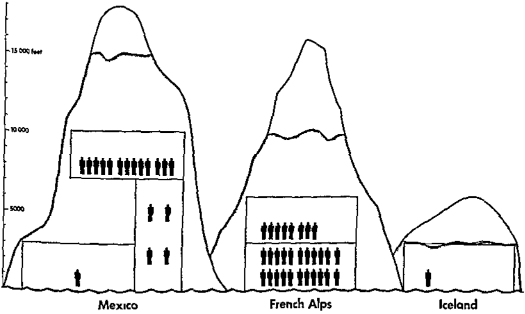
II. THE ECOLOGIST AT WORK

Suppose we look next at a few practical problems which the ecologist has helped to solve. Let us take first a very simple one. In 1913 southern Ohio had

Vegetation and Altitude



Population and Altitude



Each symbol represents 10 inhabitants per square mile

These two pictographs show the effects of altitude on vegetation and on population in three different latitudes. On the opposite page is an explanation of the symbols used and a discussion of some of the points illustrated here

a destructive flood, sometimes called the Dayton flood. The people were determined that this would not happen again. They built great dams of earth across the valleys north of Dayton to hold back the flood waters. But the sloping sides of these dams were mostly gravel with a little clay. They washed away very easily. It was necessary to get some kind of cover on these steep slopes as quickly as possible.

An ecologist was asked for his advice. He knew what plants would grow best in such places and recommended that alfalfa and clover seed be scattered on the hillsides, followed by brome grass and Japanese honeysuckle. Today the slopes of the dams are covered with a fine turf which holds them in place, while many of the hills on neighboring farms have been washed and cut by running water.

Somewhat like this is the valuable work done in the "dust bowl" region of Texas, where the sandy soil of that dry country had blown into great dunes or heaps as a result of plowing it for wheat. To level off these dunes with machinery would be very expensive. So the ecologist at work there found plants which would grow near these shifting dunes. Those in front of the dunes caught and held the soil as it blew into them, while those behind the dunes kept the rear from blowing deeper. In a remarkably short time the wind had leveled off the high tops of the dunes and the vegetation had anchored the soil in place.

Measures to Conserve Our Wild Life

A good example of ecological work with animals is to be found in the studies of ducks and other migratory wild fowl. When these birds grew scarce, state and federal agencies sought ways to protect them and increase their numbers.

They first recommended laws to forbid shooting in the spring as the birds were flying north to nest. Each female killed in the spring meant one less brood returning in the fall. Further studies showed that many of the breeding places were being destroyed by careless draining of the land for other uses. Often such places were not fitted for permanent agriculture and so the money expended in draining them was worse than wasted. By capturing birds and putting numbered aluminum bands on their legs, their breeding places and movements were traced and it was shown that the problem was international. As a result of this discovery, it became necessary for the United States government to work in close coöperation with its neighbors in Canada and Mexico.

It became important, too, to know about the food habits of the birds. For it is not enough to protect the birds from hunters or to see that they have places to breed. If proper food for them is not available, they will starve and disappear anyhow. Experts examined the stomach contents of many thousand birds from all places and at all seasons of the year. From their work we learned that this food consists largely of plant materials which are most abundant under favorable natural conditions, and that to provide these materials it is necessary to have areas undisturbed by man and uncontaminated by the poisonous wastes of his factories and cities. (*See also* Birds.)

A Mistake That Had to Be Corrected

The ecologist sometimes finds that measures which seem practical to the average man are really mistakes. A few years ago both cougars (mountain lions) and deer were abundant in Grand Canyon National Park and in the adjacent Kaibab National Forest. Because cougars preyed on deer, hunters were allowed to shoot them in the Kaibab until they almost disappeared. With their chief natural enemy gone, the deer increased so rapidly that they consumed more forage than the Kaibab could produce. They stripped it bare of every leaf and twig they could reach and destroyed large areas of forage in the Grand Canyon Park as well. The deer grew feeble, and many of them were born defective. Finally it was found necessary to throw the forest open to hunting and thus reduce the size of the deer herd to the feeding capacity of the range. The cougar, on the other hand, was protected, in the hope that the few survivors would multiply and that cougars would then resume their ancient function of keeping the deer herd down and of killing those deer not vigorous enough to be

STOPPING AIR INVASIONS BY INSECTS

Because airplanes entering the United States from foreign ports may be carrying new insect pests as stowaways, the planes are thoroughly inspected and fumigated with cyanide gas as soon as they arrive. The fumigator wears a gas mask for protection.

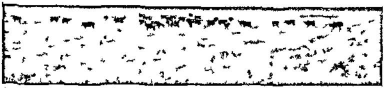
good breeding stock This is only one of many instances to prove that interference in the balance of nature cannot safely be undertaken without careful study

Control of Pests

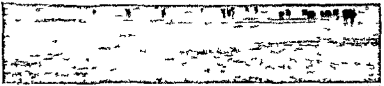
With the aid of ecology new and better methods of dealing with insect and other pests are being developed America suffers especially from such pests because many of them have been introduced from the Old World where they had been held in check by their natural enemies and where the plants or animals they infested had somehow become adjusted to getting along in spite of them Introduced without these checks and with unlimited food available because of the replacement of native plants and animals by domestic ones pests have often spread like wildfire.

Our first efforts to control these pests were a good deal like calling out the fire department We tried poison sprays and other violent means These methods are expensive and not always *successful Gradually we are* trying to replace these emergency methods by measures which enable us to get along in spite of the pests just as we prevent fires with fireproof buildings and other precautions We have found in some cases that severe damage from certain pests—for example the Mexican *beetle and the European corn* borer—is confined to crops grown on particular types of soil or under certain conditions of moisture By changing our type of land use we can foil the insect We can control some insects by bringing in their parasites or other enemies from the lands where they *originated This has* been done with scale insects (*see* Scale Insects)

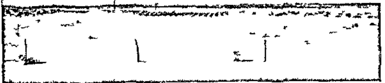
LAND RUINED BY IGNORANCE RESTORED BY SCIENCE



American cattlemen found in the West millions of acres of prairie like this where the buffalo had ranged The land covered with hardy natural grass was ideal for stock grazing But due to our ignorance much of this vast region was soon reduced to an apparently worthless desert



First the range was overstocked The grass was cropped down by cattle and sheep until it looked like this Without a sufficiently thick shield of living grass the underlying sod dried up



The government mistakenly encouraged thousands of settlers to farm this land Here was the result When the plow had broken the sod wind and rain carried away the good top soil,

To reclaim this desert was a job for practical ecologists Furrows were plowed across the slopes contour listing to catch and *hold surface water Oats sorghum* and sudan grass with a scattering of hardy trees and shrubs were *planted to hold the soil This checked the erosion*

Less than a year after the previous photograph was taken the wind blown desert had been reclaimed and looked like this Later the land was seeded to grass again and the cattle returned.

Also we are slowly beginning to see that by destroying the breeding places of our native birds and other animals we have lost valuable allies in our endless war with insects. Recently when the sportsmen of Ohio came forward with a request to allow restricted shooting of quail, which had been protected for years in that state, the farmers blocked the proposal. They know that the cash value of a single quail on the farm is equal to that of at least a dozen chickens because of the insects it kills (*see* Quail).

The conservation of our native birds, like the restoration of our forests and rivers, means the opening up of an entirely new kind of work for the future. This work we may call *designing the landscape for civilization*. As yet we have scarcely made a beginning.

Finding How to Avoid Old Mistakes

As further examples of practical work which the ecologist has done, we may cite his studies of competition among forest trees; the building of soil through the activities of plants and animals; the restoration of streams and lakes through better control of the land which drains into them; and the behavior of the root systems of plants. In the past few years, great progress has been made in this last-named work. Already the study of this underground realm of life has given us a much better understanding of prairie pastures and fields of growing crops. The effects of competition, drought, mowing, severe grazing, and burning are much better understood than they were before we knew how roots grow and behave. Means of avoiding old mistakes are at hand for those who will use them.

III. IMPORTANT PRINCIPLES OF ECOLOGY

Because ecology is so new and deals with such complicated relationships, it is difficult to set down a list of laws or principles and say: "These are the laws of ecological science." Many such principles are known, but a statement of them and an arrangement of them which would seem reasonable to one worker might not seem so to another.

Each Living Thing Has Particular Needs

We might state one principle as follows: *The pattern of life reflects the pattern of the physical environment.* If one travels west from Indiana and looks at the woods as he goes, one will see that the beech tree is not found much farther west than Chicago. The sugar maple extends to Iowa, and then disappears. The red oak and the linden are found in forests on the west bank of the Missouri, and the hickory a little farther west. Beyond that, only a handful of eastern trees remain, including the bur oak, and there they are found only along streams. Now, a study of the weather records will show that from Indiana to Nebraska the climate rapidly becomes drier. Of the trees named, the beech is most sensitive to dryness and sunlight, and the bur oak least so. Thus there is a reason for the order in which the trees drop out from east to west. As one moves on west, moreover, new plants appear which are suited to drier conditions. In the same way, if one starts in at Alabama and moves up to Michigan, one will rapidly leave the live oak, the yellow pine, the sweet gum, and the persimmon—trees which require long warm summers and mild winters.

In short, every kind of plant and animal has a certain set of conditions of moisture, light, temperature, and so on which are necessary to its growth. Where such conditions do not exist, the plant or animal cannot survive without artificial help. Man and his dog seem at first to be exceptions to this rule, for they live all over the earth. But even they cannot live beneath the sea, or in the highest layers of the atmosphere. They too have their limits. The fact that their limits are so wide is due to man's capacity to provide what we might call artificial conditions, through the making of fire, and the building of shelters, and the use of clothing and tools. Without these aids, much of the earth would be closed to man as it is to the polar bear, the camel, and the beech tree.

Communities of Plants and Animals

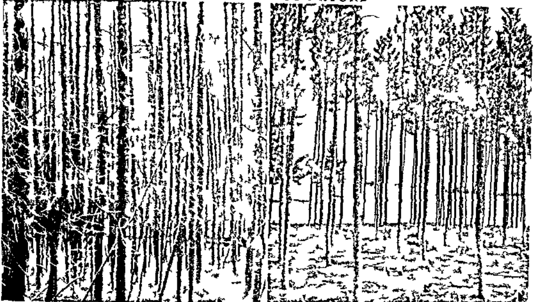
Closely related to this is a second principle, already referred to at the beginning of this article. *Plants and animals tend to group themselves into definite associations known as communities.* The groups of forest trees described above make up one great community called the Eastern Deciduous Forest of North America. The dropping out of one tree after another was really the shading off into another community, called the Grassland Formation or Prairie and High Plains. A third great community is the Desert. Within these large communities are smaller ones with their proper animals and plants. The bison, the coyote, and the jack rabbit were part of the Grassland community, just as the fox squirrel, the wood pigeon, and the black bear were part of the Forest. Furthermore, the Indian tribes who lived in these communities were really part of them because they had to suit their methods of getting food, shelter, and clothing to the conditions around them. They were interdependent with the plants and animals among which they lived.

Succession and How It Is Brought About

A third great principle is this: *Existing communities are the result of a long period of growth and development.* During this time they gradually become changed until, as we say, they fit the conditions under which the community exists. The coming in of aspen after a fire, with its eventual replacement by spruce and fir mentioned earlier in this article, is an example of such a change. Any change in a community, whatever may be its cause, is known as *succession*. Among the causes of succession are changes in the pattern of climate; changes in the pattern of land surface; changes brought about by the community itself; and changes due to the introduction of new forms of life. The last includes the very serious changes produced by man.

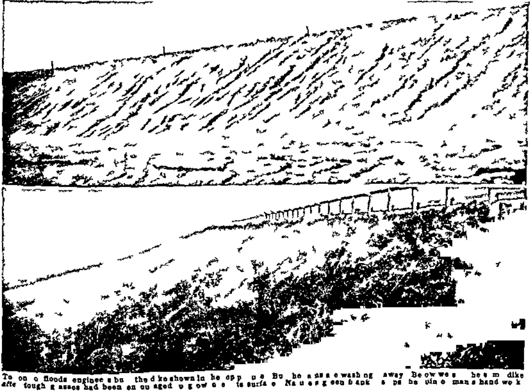
As an example of the effect of climate changes we have the drought of the 1930's in the prairie states. This was only a temporary change. Yet it resulted in the death of many kinds of tall moisture-loving grasses and their replacement by smaller, drought-resistant grasses and weeds. As the climate grows more moist again, the old grasses will doubtless return slowly.

HOW MAN HELPS NATURE



The young p nes a he eft ha e sp ung up so se g he tha h e la h e hance f any o h m to grow n o fin a tr
Bu along comes a fo es e and u s down ou ou o e e y fi e as shown a h gh V rtu ly all he su vi ors will now flou sh

HOW NATURE HELPS MAN



To on o floods enginee s bu the d ke shown in he op p u e Bu he a ns a e wash ng away Be ow we s he s m dike afte tough g asses had been en ou aged o g ow o e ts surfa e Na u e s g een b ank s ps he ruin o man s hand wo k

Over longer periods more gradual and lasting changes occur. The five great ice sheets of the Glacial Period came down over North America and Europe and the belts of northern life moved south ahead of them. Each time the ice melted back, the plants and animals moved north once more. These changes took thousands of years. (*See* Ice Age.)

Changes in the pattern of land surface take place slowly and on a large scale, when mountains are formed or new land rises up from the sea. More rapid is the action of wind and water in carving the surface of the earth, wearing away hills and filling valleys. As this erosion takes place it changes conditions. In the absence of plant life it proceeds very rapidly, but a cover of vegetation tends to slow it down.

Ravines are at first deep and narrow, cool, moist, and shady. In such places one finds ferns, beech trees, and hemlock. But as the ravine widens and is less protected, a drier type of forest takes possession, for example, oak and hickory.

Changes are also brought about by the community itself. Every living thing helps make the world somewhat different from what it was before. The weeds growing in a vacant lot produce shade and keep the ground from drying out. They bring in insects and birds, and they enrich the soil by decaying when they die. And while the bare ground was the best possible place for the sun-loving weeds to grow, the weedy ground is better for shade-loving shrubs and tree seedlings, or, farther west, for native grasses. So in the course of time the weeds are replaced. One can observe similar changes at the margin of a pond and upon sand dunes, bare rocks, or banks of clay. Wherever such changes occur, the combination of plant and animal life changes until it is of a kind which is able to make the best use of the new conditions. Thereafter the community remains fairly stable. Such a stabilized community is known as a *climax community*. A climax community may be regarded as the most efficient, well-balanced, and permanent form in which living things can make use of available materials and energy.

Again, whenever a new form of life appears in an area from which it has been absent before, it enters into competition with forms already there. Sometimes it is astonishingly successful, as the English sparrow and the starling have been in America since their introduction from Europe. At other times it makes little impression. The Chinese ginkgo tree grows well enough in the United States, but has to be helped along by man; on the other hand, the ill-scented tree of heaven, also from China, springs up and spreads in any vacant valley or fence row.

The principle of succession can be observed in human communities. The things people do and the way they do them change as the community changes from a frontier outpost to a modern city. Factory replaces blacksmith shop; department store replaces trading post.

Man has also been a potent influence in changing the natural environment. The American Museum of Natural History, New York City, in its Felix M. Warburg Hall of Ecology and Conservation, shows the changes in a section of Dutchess County through the years. Starting with the original forest, a series of dioramas show how man changed the area by his invasion, exploitation, and destruction of natural resources.

The Interdependence of Living Things

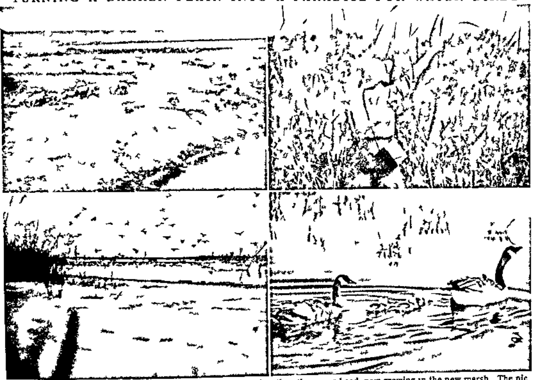
A fourth great principle may be stated as follows: *Other living things are an important part of the environment.* The wheat crop of the farmer can exist only with the aid of myriads of invisible bacteria which work in the soil. The oak tree furnishes the squirrel with shelter and food. In his turn, the squirrel often plants acorns—not intentionally, but because he forgets or fails to find those which he had buried in the soil for future use. The yucca, or Spanish bayonet plant, cannot form seed without the aid of a little moth whose young feed on its seed pods. The yucca can be made to grow in many places where it is not found, but its natural occurrence is limited to the area in which this little moth is found (*see* Yucca). There are all sorts of relationships among and between plants and animals, some beneficial to one or both, some destructive.

In a certain sense, man is one of the most dependent of all living things because he is one of the newest. He is adapted physically to the world as he found it, not as it was back in the Coal Age or the Age of Fishes. It is impossible to imagine civilized man, for example, without the great group of grasses which pasture his domestic animals and furnish him with cereals. These grasses did not appear on earth until long after the Coal Age. Man is dependent, too, upon soil, which is a product of the activity of communities of plants and animals (*see* Soil).

Competition in Nature and Human Society

This brings us to a fifth great principle of ecology which concerns *competition*. Competition is an important kind of relationship in which two living things "seek" the same required condition or material from the environment. Roots of trees compete for water, their crowns for light. Rats compete with men for stored grain. Competition is, of course, most severe between those living things whose requirements are most nearly alike. It should therefore be most severe within a single species—among wolves for meat and cattle for grass. It is often bitter and deadly among men. On the other hand there is generally within the species a pattern of behavior, even of coöperation, which leads to an adjustment. In nature one sees this in the beehive, in the spacing of trees in the forest, or in the nesting patterns of birds. Today man faces the problem of achieving a similar adjustment, using rational means. If unchecked, the outcome of human competition is war and destruction. Not infrequently such war destroys the very thing for which the groups are competing. Some measure of this may be had when we realize that a single shot fired from one of the largest modern cannon may cost as much as a simple dwelling house for a family of three.

TURNING A BARREN PLAIN INTO A PARADISE FOR WATER BIRDS



The dry prairie in the picture at the top left barely supported a few sheep but a small stream ran through. Engineers built a dam and flooded the prairie which then became a green marsh. The picture at the top right shows wild rice higher than the man's head now growing in the new marsh. The picture at the lower left shows the arrival of thousands of waterfowl. Last we see the first brood of Canada geese hatched in this bird refuge proving the value of such conservation work.

To these five general principles of ecology others might be added and they all might be stated very differently by different workers. Even so they seem to indicate clearly enough two important practical conclusions for people of today.

IV SOME PRACTICAL CONCLUSIONS

The first is this. Man has destroyed the communities of nature and is attempting to set up his own. He must study the principles which govern communities in nature if his own new ones are to be permanent. In his new task of redesigning the landscape he needs the assistance of ecology. And like the ecologist he must think less about conquering nature and more about learning how to work with nature.

In the second place man must realize his interdependence with the rest of nature including his own kind. He must find ways of controlling and adjusting the eternal process of competition so that he will not destroy the means of his own existence.

What Can We Do?

Climate.—We cannot change climate except on a small scale by making a windbreak or building a greenhouse. We can however fit our activities to the pattern of climate. This means producing plant and animal materials in the climate best suited to them and managing our farms and other lands to fit the average climate in a place instead of the exceptional. There are places where late spring frosts kill the peach blossoms five years out of six. In such places man ought to grow something else and give up his peaches. The serious dust storms of the 1930's were due to the fact that land was plowed up in wet years to grow wheat and blew away in the dry ones. Much of it should have been left in grass.

Soil.—Soil is the result of the prolonged activity of living communities. It is also a measure of the capacity of an environment to support life. It forms very slowly perhaps an inch in 500 years—and may be lost very rapidly—an inch in a single rainstorm. Therefore it is necessary that man should plan his use of the soil so that it may be kept in place and improved instead of being lost or destroyed. There is also a difference in the fitness of various soils for specific purposes. It is not wise or economical to use a soil for the wrong purpose.

Water.—Like soil water is a measure of the abundance of life. The moisture supply depends not only upon the amount of rain but upon the amount that is kept where it falls. Many of man's activities in building roads and drainage ditches in destroying the forest and the grassland and in mishandling his plowed fields cause the water to run off first bringing on

floods and later dryness. Furthermore, this running water carries the rich soil with it. From this it follows that man should study the movements of water and contrive to handle them in such a way that this water will do him the most good. (*See also* Floods; Drought; Land Use.)

Living Communities.—The communities which man establishes consist of a few kinds of plants and animals, frequently managed in such a way as to injure the environment. The natural communities which they replace generally improve the environment. Furthermore, these natural communities—notably forests and grasslands—yield many products and sources of pleasure to man. The fact that a great deal of land formerly cultivated is now lying idle and useless suggests plainly that it ought to be restored to the natural communities which once occupied it. Perhaps also by studying natural communities man will learn how to improve the artificial communities represented by his fields, gardens, orchards, pastures, and barnyards. The insect-eating native birds which breed in the natural community represented by an uncut patch of trees or bushes are among the farmer's most useful helpers.

Competition.—The most bitter competition, as was said above, can be between members of the same species whose requirements are most nearly alike. That this can happen among human beings is evident from the relentless conflicts of the business world and of the battlefield. But the various species of plants and animals also have ways of getting on together with others of the same kind which lessen the evil of competition. The obligation upon man to take similar measures should be clear. Among the most powerful instruments at his disposal are scientific understanding of his ecological problems, coöperation in solving them, and a spirit of mutual good will. (*See also* Ecology in FACT-INDEX at the end of this volume.)

The PRODUCTION *and* DISTRIBUTION *of* WEALTH

ECONOMICS. Imagine that we should be shipwrecked with a group of other people on a fertile but uninhabited island, with the prospect that none of us will get off for a long time. We would find it necessary to make a living by using the resources of the island with the aid of whatever tools we might have been able to bring ashore.

Thinking how such a group would plan and work is helpful in understanding economics, because economics studies the ways in which people plan and work together to secure things that gratify their wants—that is, to secure the goods and the services which make up what we call "a living."

It is a mistake to think of a living in too narrow or restricted a sense—as including only our food, clothing, and shelter. A living, as the economist views it, includes much more: for example, concerts or plays enjoyed at the theater; the baseball games we pay to see; journeys by motor, train, and boat; the doctor's advice, the dentist's services; the policeman's protection against violence, the work of the fire department; the services of public schools, of city milk inspectors, and of street-sweepers. It includes all the things material or intangible which we work to obtain as we pass through life.

Some very few of the things which go to make up our living we obtain without any effort. It costs us nothing to enjoy a fine view of the moon, or the comfort of warm sunshine, or of a spring wind; but most of the things which go to make up a living must be striven for. These are called economic goods, and the striving for them is called *economic activity*.

The Materials of Production

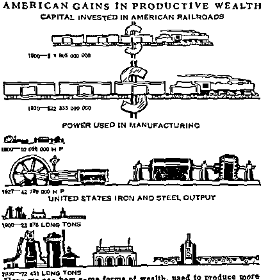
If we continue to imagine ourselves as part of a shipwrecked group, we can easily see that there are many problems which concern people in their task of making a living. If we were in such a group, we would at once begin asking ourselves: Is there a supply of good drinking water? Is the soil likely to produce good crops? Is the climate such that protection from heat or cold will be important at certain times of the year? Is there a supply of timber which may be used for buildings or making implements? Are there mineral resources of stone, iron, or copper? A very important immediate question would be: Are there wild animals, or birds, or shellfish, or fruits, or nuts, or berries which may be used for food supply? An economist thinking of these problems would ask: What are the natural resources of the island? For economists give the name *natural resources* to the useful materials which nature supplies.

Implements of Production

Other questions that we would surely ask, if we were on the island, would be: Has anyone a gun? What is the community's supply of knives and compasses? Has anyone brought ashore spades, or hoes, or axes, or matches, or flashlights? All such things would be very helpful to the members of this pioneer community in using the natural resources which they found. In the economic life of a developed society like the one in which we actually live such implements are also useful. Even more useful are other forms of tools, such as railroads, electric power plants, paved streets, hard roads, office buildings, factories, and many other forms of equipment which we have constructed to help us turn natural resources into goods to gratify our wants. The economist, whether he were describing the situation on the island, or in the world at large, would use the term *capital* to designate all the implements used in converting natural resources into consumable goods. Capital is defined as goods made in the past and used, not for consumption, but to make more goods.

Another question which would be very important to us, if we found ourselves on the island, would be the question of man power. If all of us were very old

and feeble, or very young and inexperienced, our chances of being comfortable, or perhaps even of staying alive, would be poor. *We would be more* likely to be happy if our group contained a good proportion of youth and strength, of maturity and wisdom, and of persons who had special skill in building, farming hunting, fishing, cooking caring *for the sick* organizing, and planning Considering *all the physical* and mental ability of our group as a *single quantity*, we may call it the *labor power* of our community Labor power is the *term economists use* to name the working ability of the people of a nation or of the entire world.



Here we see how some forms of wealth, used to produce more wealth, increased during two census periods

Every *factor* which we have seen to be of importance on the island is important in the economic life of a community, of a nation, or of the people of the whole world The basic factors of production—those things which are *of fundamental* importance—are *natural resources, capital equipment, labor power* During all of our lives *everything that* we may hope to obtain as a social group must come out of these resources It is not strange, then, that wars have been fought to possess land, or coal-fields, or *iron* mines, or to conquer people for the sake of exploiting their labor

As time goes on, we are making certain improvements and perhaps suffering certain losses in these three factors of production In the United States, for example, the people have used up a great deal of the timber supply, they have made considerable inroads on the deposits of coal, iron, and copper, and they have consumed large quantities of the natural gas and petroleum On the other hand, the people have expanded their available natural resources greatly by discovery and invention When the West was opened it gave vast new farm lands The discovery of coal, iron, copper, and gold added to the physical resources Quite as important are the discoveries that have been made in the fields of chemistry and physics When the steam engine was invented, for example, the resource of the expanding properties of water as it turns to steam added untold value to the supply of Nature's gifts Achievements in the fields of electricity and radio have tapped other resources undreamed of a few generations ago In the capital equipment of the United States additions have been vastly greater than losses as the picture herewith shows, although fire and flood and wind and earthquake take a toll each year, and wear takes a larger one

American labor power has also increased, partly as a *result* of growing population and partly as a result *of education*, which has taught men how to work more effectively In the early days of the United States an increasing population was important A larger population could make better use of the varied *types* of physical resources in the United States, and there could be better specialization for producing various types of goods It is very doubtful, however, whether the United States now gains by further increases in population As population has increased it has become necessary to utilize not only the best soil and other natural resources but much that is of second and third grade When such resources are utilized, there is not as large a return per person as is the case when only *the* better grade is used As the population has to apply itself to poorer lands, and to coal and other minerals which are deeper in the earth or farther from factories, there is a strong force at work tending to make the average income less than it would be if the population were smaller and applied itself only to the better resources

It is of great importance to production that *society's* materials—natural resources capital equipment, and labor power—should be brought together and related effectively if society is to secure the greatest quantity and highest quality of economic goods The task of planning how natural resources, equipment and labor power shall be combined, is the task of *organization*. Wherever people are found working in groups, organization is to be found Even on our imaginary island we should probably elect a president or a general manager who would plan and direct the work of the others

The Organization of Economic Activity

There are several ways in which the work of organizing our economic activity is carried on. A little of it is done by families and a little by clubs and other such organizations. But there are two methods which are important far beyond any others The first may be called *organization by individual enterprise*

This simply means that we permit people who wish to organize part of our economic activity to do so. If a man or woman thinks there should be a new store, bank, furniture plant, or automobile business,

he or she may organize one. He is free (though with certain important controls in some lines of business) to put together the necessary natural resources, labor power, and capital equipment, in the way that he decides is best. Every head of a business is an example of an "enterpriser" (or *entrepreneur*, as French economists call him), who is taking some responsibility for organizing our materials and producing some of the things that people want in making a living.

Public Enterprise or Government

A second way of organizing is by *public enterprise.* We have our national government, our state, county, city, township, and other governments, which are formed by groups of people as ways of getting things done. Indeed, a government has no real purpose unless it is a sort of committee by means of which a larger group works to carry on economic activity.

Some persons believe that it would be a good thing if we did away with the practise of permitting business and professional men and women to act as organizers, that is, if we did away with individual enterprise, and carried on all of our economic activity by means of public enterprise. If we did this, our governments would organize factories, stores, railways, warehouses, doctors' services, and insurance just as they now organize public school education, public health service, the mail service, the road and street system, and the army and navy. The carrying on of economic activity by governments, particularly if the governments also own the materials used, is usually called social economic activity, or Socialism (*see* Socialism). The chief examples of social economic activity in the United States are the mail system, the public schools, and the army and navy. In Russia at present practically all economic activity is directed by the government (*see* Russia).

Forms of Private Enterprise

While public enterprise organizes *governments* as devices through which to work, private enterprisers organize *businesses*. Thus:

1. *Individual enterprisers* do the larger part of our organizing—
   a. By going into business. Examples are storekeepers, bankers, and farmers.
   b. By going into the professions. Examples are doctors, dentists, and lawyers.
2. *Public enterprise working through governments*—national, state, and local—does a considerable part of the work of organizing. Examples are the public schools and the postoffice.

There are three chief forms of business organization. These forms are the individual firm, the partnership, and the corporation. The individual firm is a business organized and conducted by one man, who uses in his business such funds as he can furnish or borrow, and who employs such assistants as he needs. Most small businesses are individual firms. The partnership is a form of business organization which rests on an agreement made between two or more persons that they will carry on business as partners. Sometimes all contribute money; sometimes some contribute money and others work; and sometimes all contribute money and work. They share in the earnings of the company according to the agreement made. A corporation is defined at law as a legal person which, though it has no flesh and blood, can make agreements, borrow money, and hire employees just as a real person does. Corporations are organized by the authority of the government, which grants corporate powers upon application properly made by a number of persons acting as incorporators. The corporation is managed by a president and other officers. The ownership of the corporation is divided at the beginning among the incorporators and others who have subscribed for shares in its ownership. (*See* Corporations; Stocks and Bonds.)

The individual firm is useful where the economic tasks undertaken are small in scale so that they can be looked after by one man and financed with comparatively small means. A partnership may be desirable where more funds are needed and where partners can each contribute some kind of specialized skill. The corporation has become the most important form of business unit, because it makes possible, chiefly through the sale of stock, the amassing of the enormous amounts of money needed for modern manufacture, transportation, and banking, and because its work, unlike that of the other forms, is not interrupted by the death of partners or proprietors.

The Guidance of Economic Activity

How do business men and governments decide what things should be produced and made available to consumers? Put in another and perhaps a larger way the question is, How is economic activity guided?

To answer this question we must first realize that our social materials are limited. There are not enough available at any one time to make all we want of everything. Nor is it desirable to use our resources at any given time to make only the things we want at the moment. Some raw materials, some of our labor power, some of our equipment, should be employed in keeping up and improving our productive resources so that we may get a good supply in later years.

This is not all the task, for we must not only decide between present goods for consumption and the keeping up and improving of our equipment, but we must also decide what kinds of goods to make at present—how many shoes, how many overcoats, how many hats, how many houses, how many textbooks, how many pianos, and the kinds, sizes, and shapes of each of these. And in building for the future we must decide how many railroads, how many factories, how many paved streets, how many office buildings, and what kinds, sizes, and shapes of each of these we can use.

How do governments and business men decide these questions? Those who are responsible in governments—congresses, legislatures, and boards of aldermen—usually decide by considering those things which they believe it would be socially desirable to have. On that basis it is decided that we will have public schools, public parks, a sewer system, and

HOW BUSINESS MEN AND GOVERNMENTS ORGANIZE HUMAN EFFORT

At the left *private enterprise* organizes *labor* (represented by a lumberjack upper left *natural resources* (such as timber) and *capital* (such as a sawmill) to produce wood and other needed materials then by factory manufacture and store sale it places the chair at your disposal For this you pay the sales price of the chair *Public enterprise* meets other needs by training and maintaining policemen doctors nurses schools hospitals and other agencies to help in case say of accidental injury This is paid for by the people in the indirect form of taxes levied upon incomes and property of various kinds

lighted streets Business men however act on a different principle They make what they believe will pay best For this reason it may be said that our economic system so far as business is concerned is guided by the *profit motive*

How does a business man know what will pay best? He does not always know He makes the best estimates he can by means of market analyses to determine what goods people will buy in what quantities they will buy them and what prices they will pay for them Then by cost accounting and other methods he determines as well as he can the cost at which these goods can be produced or purchased and he decides to manufacture or buy and sell those which it appears to him will be most profitable Of course if a man is once in business if he has built factories and made contracts for materials and equipment he cannot always shift easily from one line of production to another Nor are all business men interested only in what pays best Some have taste

and knowledge which influence them in their choices as much as gain. But it is no mistake to say that the chance for profit is the most significant and far-reaching motive of business men.

It is not only the business man who is influenced by what pays best. When a business man or a government has determined that a certain thing—shoes or public parks—shall be produced, the social materials which will produce them must be obtained. Although these are called social materials, most of them are privately owned. In some cases governments can get materials in part by force or through sentiment. In war, which requires a stupendous apportionment of society's materials to the making of armies and munitions, the Federal government secures men by draft or voluntary enlistment. But except in such emergency cases, governments and business men alike must resort to the process of payment.

The Return from Capital

Persons who own a natural resource or capital equipment will sell or lease it to the highest bidder. If they lease it, the return they receive is called *rent.* If they lend the curious form of capital called *money,* the payment is called *interest.* Persons with their own services to sell will work where conditions are best or salaries highest, or both. Their payment, in return for their "time" capital, is called *wages.*

Thus the profit motive is important in influencing the owners of tangible things as well as the owners of labor power to put the social materials which they control into making one thing or another. Guidance in our business system is often said to be *pecuniary guidance,* because the persons concerned count in pecuniary units—dollars—the relative advantages of doing or making one thing as compared with another.

Each of us as a consumer has a sort of vote as to what we would like to have business make. We vote with the dollars which we spend, but we do not have equal votes. Those who have larger incomes have more votes than those with smaller incomes. If the old phrase "money talks" has meaning anywhere, it has it in the guidance of economic activity, for to profits as expressed in dollars the business man and the owners of the factors of production listen closely in making their decisions.

Financial Institutions of Our Economic System

Obtaining the funds necessary to induce the owners of natural resources and equipment and labor power to furnish these is one of the most difficult tasks of both businesses and governments. Businesses secure their funds in several ways. A man may have saved enough to begin a business as an individual firm. Several men with savings may, as we have seen, join to form a partnership, or subscribe for stock in a corporation which they wish to organize. In any type of business, profits may be made from operations, and these may be employed to expand the activities. If still larger funds are believed to be necessary, a business borrows. When a business wishes to borrow, it turns for aid to other firms which are in the business of lending money. Among the important types of these financial institutions are the commercial bank, the investment bank, and the stock exchange. The *commercial bank* lends money for the daily uses of business men in trade and commerce, using partly its own funds, and partly those deposits which have been made by storekeepers, factory owners, you, me, and others who have "put our money in the bank." Commercial banks usually loan only for brief periods, although they may renew a loan many times. (*See* Banks and Banking.)

A second source of funds, particularly for corporations, is the *investment bank.* Such a bank makes a business of securing funds needed for a longer period than the commercial bank is willing to lend. A corporation dealing with an investment banker prepares bonds, printed or engraved, which are signed by the proper corporation officers. The investment banker buys these and thus supplies the corporation with the needed funds. The investment banker, in turn, sells these bonds to investors at a price higher than he paid

The Function of Exchanges

The *stock exchanges* in New York and other large cities are of great importance in providing funds for business, because they serve as market places where bonds and stocks may be sold. People are more willing to lend money to corporations, that is, buy the bonds of corporations, or to buy their shares, when they know there are markets in which they can sell these securities if they wish.

The ability of corporations to secure large funds through issuing stock and through borrowing has led to certain serious problems. Many people are concerned because these companies thus obtain control over such a stupendous amount of capital that they can exercise far-reaching power, which may be viewed as dangerous. The movement toward great concentration of wealth was earlier called "the trust movement." It is now also commonly referred to as "the merger movement." (*See* Monopolies and Cartels)

To some extent, governments secure their finances by the same method which private businesses use. They borrow from banks and issue bonds. They have one important method of securing funds, however, which private business may not employ. This is taxation. Taxes make up the largest single factor of government income. (*See* Taxation.)

Modern Production: The Mass and Machine Method

With natural resources, capital equipment, and labor power purchased, businesses or governments may proceed to production. It has now become generally recognized that in economic operations—both of business and government—there are usually economies in large-scale production, or so-called "mass production." The chief saving comes because power and machinery can be applied most effectively to performing over and over again the processes called for in such production. As a result, most modern factories and power plants are repositories of vast machine equipment. The extensive use of machinery.

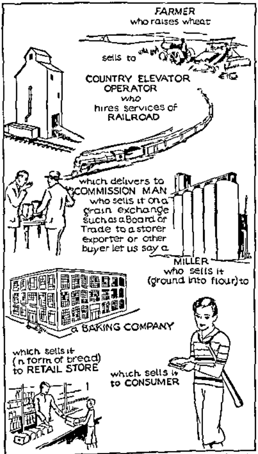
although enormously productive of goods, involves undesirable factors. First is the risk involved in large investment in a fixed form If a new invention makes an old machine useless, the investment in the machine may be lost If a change of styles causes consumers to refuse to purchase the goods formerly produced by a great factory, its owners may find that its great machines represent merely a financial burden For the workers, also machines have made serious problems First of all, a machine by its very efficiency puts men out of work, and although such unemployed persons may eventually find new places in the economic system, they do so often only after serious privation and suffering The building of great factories has been responsible also for much of the concentration of people into crowded cities, and this in turn has given rise to many questions involving health, behavior, education, and government (*see* City) Machines each year cause an appalling number of industrial accidents and deaths, and, with their noise and monotony of operation, bring fatigue and nerve strain in labor The good and the bad features of machine production exist whether the machine is employed by private business or by government, whether in an economic system of private enterprise, or in a socialistic economy.

Specialized Production

Few single enterprises, whether private or governmental, whether farms, factories, or stores, attempt to perform all the processes necessary in making goods for consumers The farmer raises wheat but it is hauled to a large city by a railroad, ground into flour in a mill, baked in a large bakery, distributed by trucks to retail stores, and there sold to housewives. Production of bread requires all these steps, and production is not completed until the bread is ready to be consumed

This dividing of the task of production, among many units, which is common in our economic world, is called *specialization of economic units* Still further specialization exists within each one of the specialized business or governmental units This division of labor among specialized units would not be possible if they were not related or organized in some way. Yet there is no general management of all of them They are integrated only by the agreements which they make in buying and selling among themselves

THESE PEOPLE PROVIDE YOUR BREAD



Here are only a few of the steps taken by many people in order to furnish the world's bread The example is worth noting, because it illustrates the process when a commodity exchange enters into the system.

This great amount of buying and selling takes place in part in very highly organized markets and in part in very informal ways in men's offices or by letter, telegram, and telephone call In some cases the factors of competition are ever present and force prices up and down as supply and demand dictate In others there is much less competition, and sellers are sometimes able to secure much higher prices than would be the case if competition were more keen

The Work of An Organized Market

Buying and selling are so important in tying our production into a system that at least one important type of market should be described There are few markets better organized than those called the "commodity exchanges" One of the largest, dealing chiefly in grain, is the Chicago Board of Trade, where many millions of bushels of wheat, corn, and other grains, are sold each year Any farmer, country elevator operator, or other owner of wheat may send grain to a proper agent at this or any grain exchange (there are important North American ones in Minneapolis, St Louis, and Winnipeg) and have it offered *for sale* The grain, which usually comes in carloads, is tested and graded by government inspectors Samples are placed on tables, buyers examine them, and sales are made to those who offer the best prices All exchanges are in continuous touch by telegraph As orders for wheat for milling purposes, for exporting, and for storing are sent from all parts of the country to agents in the various large markets and,

indeed, from all parts of the world, there is brought to bear on the grain shipped into the organized markets on any given day the world's demand for grain on that day. The prices in different markets are kept close together by inter-market selling called "arbitrage" (*see* Boards of Trade). Thus any seller, even of a single car, is reasonably assured of securing in any market as much as is justified by the world demand on that day.

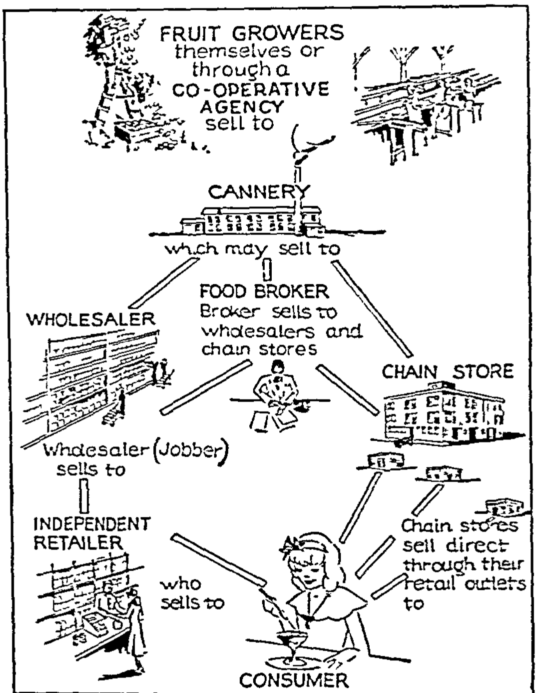
In deciding what prices should be paid for grain on any given day, buyers and sellers also consider the supplies which may be available later. Such supplies can be considered because of a far-reaching service of the Federal government in gathering information about stocks of grain in the hands of farmers and other storage points both in the United States and in other parts of the world. Even the promise of crops now growing but unharvested, and the prospects of crops yet to be planted, as these are shown by weather and soil conditions, are included in the reports made.

On the large grain exchanges there is a market not only for grain actually shipped in on a given day (called "spot" grain) but also for grain to be delivered in the future. On this market one may sell at a definite price but for a delivery in some future month. Prices in this market are also determined by buyers and sellers who consider factors which are to be effective in the future.

Because the grain exchanges furnish places at which the supply of grain and buyers for it are concentrated, the thousands of producers of grain need not hunt for customers. They need only send their crops to the central markets. Selling costs are, therefore, comparatively low. The futures markets, in addition, forecast what the most critical judges believe will be the price some months hence. A buyer or seller is thus guided in determining whether he wishes to sell immediately or in the future. The futures markets are also of value to producers who are considering putting in seed for new crops, for by seeing the probable price in the future, the grower is better able to estimate the chances of profit. Similar services are provided for other commodities, such as cotton and rubber, by their individual exchanges.

If one follows wheat along toward the consumer, he will not find another market so well organized as the grain exchange. When the miller offers flour for sale, it is often under his own brand; and when the baker offers bread, the same is usually true. Both (as do many other manufacturers, of course) strive by advertising to persuade the consumer that their brands are best. Such advertising seldom reveals the intrinsic qualities of the goods, as does the government testing on the exchanges. Among the many questions which need careful thought in our economic organization is that of arranging that the buyer may know what he is buying and how to make some comparison of its merits with those of other available goods.

HOW CANNED FRUIT REACHES YOU



Many of the steps above are similar to those for supplying bread, shown on the preceding page—but here there is no commodity exchange in the process.

The Distribution of Social Income

When materials have passed from the farm, the mine, or the quarry, and perhaps through the factory, the wholesale warehouse, and the retail store, they come to the consumer as "produced goods." But how many shall go to each consumer? What division shall be made of all the goods and services produced by governments and businesses? How much shall each of us receive? As an economist would put it, what shall be the *distribution of social income?*

Light is thrown on distribution of both governmental production and business production by what was said earlier concerning guidance. Governments produce public school systems. They are available on equal terms to all. Thus one might say that in a sense they are equally distributed. It is not true, however, that all are equally benefited, for an old man with no children may pay heavy taxes, whereas a young couple with several children may have very small taxes. A city provides fire protection without charge, but some persons own many buildings which need fire protection, whereas others have none. In all such cases we may say that governments distribute to each according to his need so far as they distribute to any.

When we turn to distribution of goods produced by business in our economic system, we find a different picture. These are not offered free of charge, or according to need. They are offered in quantities and

qual ties according to our ability to pay What each one gets therefore as his share in the distribution of the products or goods produced by business is what he is able to pay for What any one of us is able to pay for depends upon what he has What we have at any moment is the result of what we have obtained in such ways as inheritance marriage or gift or by saving from *income* Income may be in the form of wages (payment for work) or interest (payment for funds used) or rent (payment for other resources) (For a list of terms commonly used in economics and in business generally *see* Economics in the FACT INDEX)

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LAND *of Tropic* HEAT *and Perpetual* SNOW

ECUADOR (*ĕk′wa-dôr*). The Spanish word for equator is the suitable name of South America's smallest West Coast republic. The equator runs across Ecuador. Its lowlands are like other equatorial lowlands, with their steaming heat and tangled rain forests. In contrast, however, Ecuador's lofty Andes Mountains are bleak, chill, and studded with snowy peaks.

Ecuador's peoples contrast sharply too. Savages hunt in the wild rain forests. Stolid Indian farmers till the highland basins. Whites and mestizos live in the cities and take part in government, industry, and trade. It has been difficult to weld such varied peoples into a stable nation.

The country stretches from 2° N. latitude to 5° S. along the Pacific. Its northern neighbor is Colombia. Peru surrounds it on the south and east. Its area has not been measured but has been computed at about 106,000 square miles—twice as large as Arkansas. Once the nation claimed a vast area on the south and east, but much of this was given to Peru by international arbitration in 1942. Ecuador also owns the Archipiélago de Colón, or Galápagos Islands (2,868 square miles), lying 600 miles out in the Pacific Ocean. (*See also* Galápagos Islands; for map of Ecuador, *see* Peru.)

How the Land Lies

A broad costal plain curves some 425 miles along the Pacific Ocean. Hills rise between this plain and the fertile basin of the Guyas River. Inland, the Andes Mountains reach from north to south in two giant ranges—the Cordillera Occidental and Cordillera Central (*see* Andes Mountains). From them rise the beautiful, tapering cones of some 30 volcanoes. The highest reach far into the region of permanent snow. The molten lava from the active craters reflects red against the clouds at night. Mount Chimborazo, 20,702 feet high, is Ecuador's highest peak. Mount Cotopaxi, 19,498 feet high, is the world's loftiest active volcano.

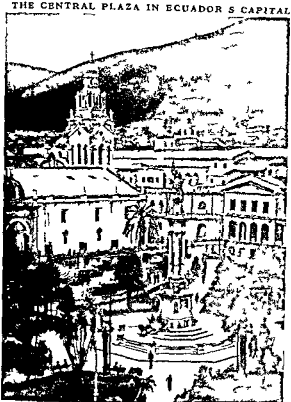
Between the Cordilleras a vast trough, 20 to 50 miles wide, extends 250 miles. Its elevation averages between 7,000 and 9,500 feet. Cross ranges cut it into ten basins, each with a river system, flowing westward toward the Pacific or eastward toward the Amazon River. On the east, the mountains drop abruptly to interior plains. Through this region, called the Oriente, meander tributaries of the Amazon (*see* Amazon River).

How the Climate Affects Plants and Crops

Tropical heat lasts the year around on the western lowlands. Guayaquil, the chief port, has an average annual temperature of 77.5° F., with a maximum of 93° and a minimum of 67°. Most of the region is wet, humid, and clothed in rain forest. In the north the rainy season lasts from December to June. It becomes shorter toward the south. The Santa Elena peninsula, west of the Gulf of Guayaquil, and the south coast are dry. Here begins the desert strip that follows South America's South Pacific coast.

Where the climate is hot and rainy many tropical crops flourish. Rich, well-drained soils lie at the foot of the mountains where the streams have dropped

THE CENTRAL PLAZA IN ECUADOR S CAPITAL



Qu to is one of the oldest c t es in the Western World It was a center of Indian cu ture long before the Incas in the 15th century made it one of their four district capi als On the Plaza Mayor shown above stand the cathedral and the principal government buildings

a *fan* of the fert le volcanic dust they carry Here cacao and bananas are grown with coffee on the higher slopes of the fans Cattle graze here in the dry season In low warm valleys of the Andes cotton sugar tobacco and fruits are raised The flood plains of the rivers are suitable for rice From the forests the people take balsa wood kapok tagua nuts and the toquilla fiber used in Ecuador s Panama hats

The high basins of the Andes enjoy a climate of perpetual spring In Quito the capital 15 miles from the equator at an altitude of some 9 300 feet the average annual temperature is 55 2° F w th a maximum of 80° and a minimum of 38° Tempera tures drop on the bleak slopes ris ng to the snow line

Crops of cool climates are cultivated in the basins —corn wheat barley rye potatoes and quinoa Potatoes native to the Andean region may grow at an alt tude of 11 600 feet On chill lofty plateaus called *paramos* coarse grass and bushes furnish pasture for cattle sheep and goats

West winds carry volcanic ash and dust into the basins Th s material is rich in plant food but grainy and loose Ra n drains through such soil rap idly and some places are too dry for cultivation Irrigation is needed in many areas

The Oriente has a hot steamy climate Its dense ra n forest contains wild rubber and other valuable tropical trees Heat swarms of insects malaria and other diseases however make people dislike living here The region is little de veloped and only a few rough trails connect it with the h gl l nd

Peoples and Their Ways of Life

Ecuador has a population of 3 202 757 (1950 census) About half are Ind ans A third are of mixed Ind an and white blood called *mestizos* on the lowlands and *cholos* in the highlands Ten to 15 per cent are Negroes Most Negroes live on the northern coastal plain and are de s endants of Africans cast ashore when a slave sh p was wrecked

Only 6 to 8 per cent are whites of Spanish de scent but they control the wealth and govern ment of the country They live in Quito Guaya quil and the small cities at the heart of the h gh land basins A few are large landowners hold ng estates granted to their ancestors when Spain ruled Ecuador Others engage in the govern ment and the learned profess ons

The highland basins are the most thickly peo pled areas The Indian farmers have lived here since prehistoric times Their lungs are adapted to the th n air of the high altitudes They speak Quechua the language of the Inca empire rather than Spanish Ecuador s official language Using crude metl ods and tools of long ago they pro duce nearly everything they use by farming herd ng and home crafts Most of them farm the great estates on a share basis but a few have plots of their own They may send their herds to pasture on land still held in common by the community On market day they trot to the village burdened with a pack of hides wool or surplus grain to trade with their neighbors

These *serrano* Indians have few dealings with the *costeños* of lowland Ecuador and take little interest in the nation They have more in common with the Andean Indians of Peru and Bol via living in the same kind of thatche l huts and wearing similar bright ponchos or colorful skirts and shawls (*see* Bolivia) The article South America section The Pattern of Human Life contrasts these agri ultural Indians with the few scattered primitive tribes who live by hunting fishing and tilling a garden patch in the Oriente and in the wilder parts of the coastal forest

The people of the lowlands are chiefly mestizos They work on the great plantat ons or on their own small farms ra sing cacao bananas rice and coffee crops for export They depend on world trade for a livelihood and buy the imported goods they can afford

Industry and Transportation

Ecuador s income comes almost wholly from exporting tropical crops and forest products It is not a wealthy country Usually bananas cacao coffee and rice make up more than 80 per cent of its exports It lacks the huge m neral deposits of other Pacific coast

countries. Gold is the chief metal—exported as cyanide precipitates (*see* Gold). The Santa Elena peninsula yields almost enough petroleum to supply the needs of the whole country.

Poor transportation has retarded the country's development. Roads are few in the coastal plains. The products are floated down the rivers on rafts for shipment on ocean vessels. The chief railroad is the 281-mile line scaling the wall of the Andes from Guayaquil to Quito. Feeder lines connect with a few highland centers. The Pan American Highway runs down the central valley of the Andes from Colombia. A link is incomplete north of the Peruvian border. Few other roads are passable in wet weather. Airlines connect Guayaquil and Quito with other American countries and local lines tap smaller cities.

Textile manufacturing ranks first among the few local industries that make goods for everyday use. Hand-woven "Panama hats" are made for export in Chone, Jipijapa, Montecristi, and Cuenca.

The two big cities differ greatly. The commercial capital, Guayaquil, is the larger, with 258,966 inhabitants (1950 census). Streets running back from the water front hold modern stores, offices, and warehouses of concrete and steel, rebuilt after destructive fires. Quito (population, 209,932) contains some of the most beautiful colonial buildings in South America. Its ancient churches and convents hold treasures of religious art.

History and Government

When the Spanish conquistadors reached South America, Ecuador's advanced agricultural Indians had only recently been absorbed into the Inca empire (*see* Incas). After Francisco Pizarro vanquished Peru, he sent Sebastián de Benalcázar northward in 1533 to overrun the region (*see* Pizarro). It became part of the Spanish Viceroyalty of Peru and remained under Spanish rule until freed by revolutionary troops in 1822. It first joined with Colombia and Venezuela in the republic of Greater Colombia, under the presidency of Simón Bolívar (*see* Bolívar). In 1830 it was made an independent republic.

The history of the republic has been stormy. Poverty of resources, disunity, and illiteracy raised problems the ablest leaders could not solve. Many presidents were deposed and several assumed dictatorial powers. Clashes over religion led to the disestablishing of the Catholic church as the state religion in 1906. More than a dozen constitutions were adopted.

The constitution of 1945 provided for a president elected directly for a four-year term and for a legislature of one house with a two-year term. Free and compulsory schooling is called for by law, but the whole country has fewer than 5,000 schools of all kinds, and illiteracy is high. The four national universities are in Quito, Guayaquil, Cuenca, and Loja.

Under the Production Development Law of 1949, the government took steps to improve economic conditions. It financed flour mills, canneries, cement plants, and hotels for tourists. It provided disease-resistant seedlings for the cacao plantations and pushed agricultural experimentation. The United States sent in farm experts to aid in this work under the Point Four program. (For further study of Ecuador's culture, *see* Latin America; Latin American Literature; for geography, Reference-Outline, and Bibliography, *see* South America.)

EDDY, MARY BAKER (1821–1910). The distinction of being the only woman to establish a great religious faith belongs to Mary Baker Eddy, the founder of Christian Science. Born on a farm near Concord, N. H., Mary Baker was a beautiful but delicate child, thoughtful and deeply religious. In her early womanhood she married George W. Glover and went to live in Charleston, S. C.; but in about a year her husband died, and she returned to her parents' home.

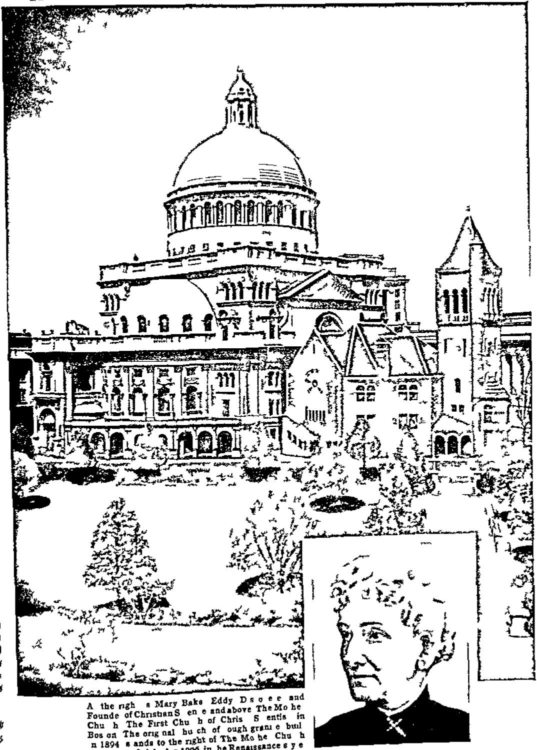
For many years her health was delicate, and in her distress of mind and body she turned to the Bible for consolation. Gradually there came to her the conviction that God is infinite Spirit or Mind, the divine Principle of all real being, and that since He is infinitely good, there can be no real evil. What we call sin, sickness, and death are only errors of mortal mind, and when these errors are destroyed mind and body are healed.

"The falling apple," as she herself expressed it, which after 20 years of seeking led to the discovery of the principle of Christian Science, was an accident from which she recovered in a seemingly miraculous manner. On the third day after her injury, when she lay apparently at death's door, she called for her Bible and read the account in Matthew ix of how Jesus healed the palsied man. Then, in her own words, "As I read, the healing Truth dawned upon my sense; and the result was that I rose, dressed myself, and ever after was in better health than I had before enjoyed." ('Miscellaneous Writings', p. 24.)

This was in 1866. Then followed years of profound thought and study of the Scriptures, the results of which were given to the world in 1875 in her book, 'Science and Health with Key to the Scriptures', the textbook of Christian Science.

Among the little group of students who had gathered around her was a grave, sweet-tempered man named Asa Gilbert Eddy, whom she shortly afterward married. He lived only five years after this, but he was of great help to Mrs. Eddy in the early and troublous years of the Christian Science movement.

In 1879 Mrs. Eddy organized the church in Boston which came to be called The First Church of Christ, Scientist. From this "Mother Church" branches quickly spread to all parts of the United States and even to foreign countries. For many years after her husband's death, Mrs. Eddy continued to lead a very busy life, teaching large numbers of students, editing *The Christian Science Journal*, and inspiring eager congregations. Her last years were spent at Pleasant View, her home in Concord, N. H., and at Chestnut Hill in Newton, a suburb of Boston, Mass. She remained the active leader of the Christian Science movement until she quietly passed away on Dec. 3, 1910, in her 90th year.



A the righ s Mary Bake Eddy D s o e e and Founde of Christian S en e and above The Mo he Chu h The First Chu h of Chris S entis in Bos on The orig nal bu ch of ough grani e buil n 1894 s ands to the right of The Mo he Chu h Extension finished n 1906 in he Renaissance s y e

EDINBURGH (*ĕd''n-bûr-ō*), SCOTLAND. One of the loveliest cities of Europe is Edinburgh, historic capital of Scotland. It is built on a series of ridges, separated by ravines, and its buildings harmonize with its unusual setting.

Edinburgh lies on the south shore of the Firth of Forth, a long arm of the North Sea. The Old Town grew up on a mile-long rocky spine that rises at its western end to massive Castle Rock. North of this ridge lies a deep ravine. Beyond the ravine spreads the spacious New Town, which dates from the 18th century. Modern suburbs stretch southward into the beautiful Pentland Hills and northward to the shores of the Firth of Forth. Leith, Edinburgh's port, was added to the city in 1920.

On the summit of Castle Rock stands Edinburgh Castle, an ancient home of Scottish kings, now a museum of old armor and weapons. On three sides the Rock drops sheer to the valley below. To the east the Royal Mile (High Street and Canongate) runs along the ridged backbone of the picturesque Old Town. For hundreds of years the Old Town was crowded within protecting walls and had to grow upward rather than outward. Its old stone houses—now tenements of the poor—are 10 and 12 stories high. The little side streets, called wynds or closes, are steep and narrow. In the Old Town are St. Giles Church, where John Knox often preached, and the old Parliament House, now used by Scotland's Supreme Law Courts and by the Scottish National Library. On the southern slope is the University of Edinburgh, founded in 1583, which has long been famous for its medical school. The Royal Mile ends at Holyrood Palace, where the rooms of Mary Stuart, Queen of Scots, are still preserved. South of the palace spreads treeless King's Park, from which rises Arthur's Seat, a mass of rock more than five miles around.

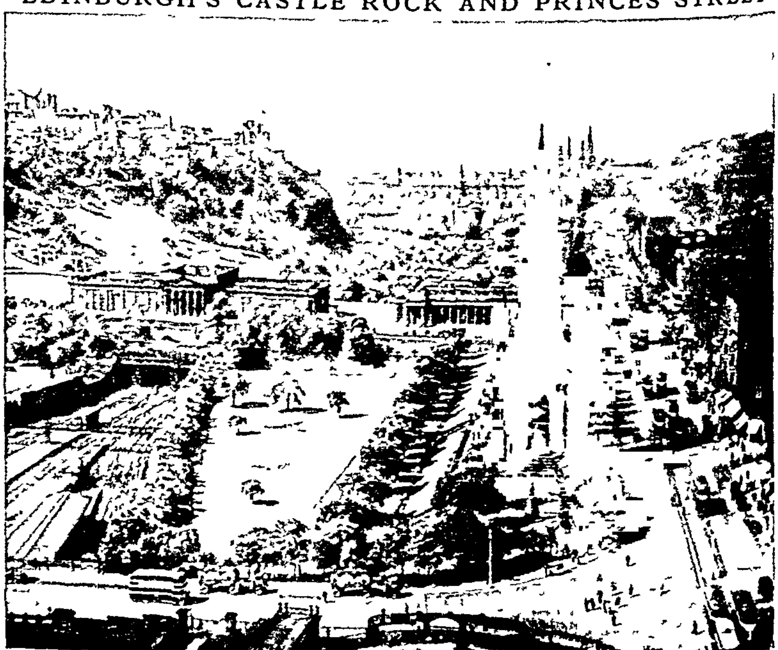
The New Town is connected with the old by bridges across the ravine and by the Mound, an artificial causeway. On the Mound are Scotland's two most famous art centers—the National Gallery and the Royal Scottish Academy. A railway runs at the bottom of the deep valley, but the slopes are covered with beautiful public gardens. Princes Street, a world-famous thoroughfare, faces the gardens. On the north side are shops, clubs, and hotels. In East Princes Street Gardens stands an ornate monument to Sir Walter Scott. In its many niches are statues of famous characters in Scott's writings. Behind Princes Street runs the somewhat higher George Street and then Queen Street, lined with stately business houses. In St. Andrew's House are the official departments that administer Scottish affairs.

Edinburgh was affectionately nicknamed "Auld Reekie" because of the smoke (reek) from its thousands of chimneys. It is also called the "Athens of the North" because, like Athens, it won renown as a city of culture. In the 18th and 19th centuries it was the center of a brilliant literary and philosophical circle that included David Hume, Adam Smith, Robert Burns, and Sir Walter Scott. Since 1947 Edinburgh has held each year at the end of the summer a three-week International Festival of Music and Drama. The performances are given by internationally celebrated artists and attract visitors from all parts of the world.

Edinburgh's principal industries are printing and publishing, rubber, brewing, and distilling. Heavy industry spreads over the industrial belt that links Edinburgh with Glasgow, to the west.

The history of Edinburgh begins in the 7th century when Edwin, king of Northumbria, built a fortress on Castle Rock. Around it sprang up the settlement of Edwin's Burgh, after which the city was named. In 1436 the city became the capital of Scotland. The union of the Scottish parliament with that of England in 1707 reduced Edinburgh's political importance, but it remained the legal, intellectual, and artistic center. Population (1951 census, preliminary), 466,770.

EDINBURGH'S CASTLE ROCK AND PRINCES STREET



Castle Rock, the highest point in the city, looks down on Princes Street, in the New Town. In the foreground, on East Princes Street, rises the Sir Walter Scott Monument.

The MOST INGENIOUS *of* AMERICANS *and His Amazing Inventions*

A "born inventor' if ever there was one Thomas Alva Edison was known as the 'boy wonder of electricity' almost before he was old enough to vote Often in early days he endangered his scant livelihood for the pure joy of working out his ideas After he had found success and fortune, the irresistible interest of his work kept him at it for long untiring hours often for days and nights together without sleep It was said of him that he kept the path to the Patent Office hot for his patents in the United States alone number more than 1 000 No other man has done half so much to apply scientific discovery to everyday life "There is not an electrical instrument or an electrical process now in use," it has been said "but bears the mark of some great change wrought by this most ingenious of Americans" His life may well be an inspiration to any boy who wants to attain the success of honored useful happy manhood

EDISON, THOMAS ALVA (1847 1931) The thing that impresses the reader of a life of Edison, first and last, is its joyousness From babyhood he was the busiest, happiest, most interested boy in the village of Milan, Ohio, where he was born on Feb 11 1847 He was too busy to play much with other boys to be sure, and at school, where he spent only three months of his life, he passed for a dunce His wise mother, however, understood her sturdy little "sober sides," and he gained the most valuable education possible through following the promptings of his unchecked curiosity He was a great reader devouring Gibbon's 'Decline and Fall of the Roman Empire' and Hume's 'History of England' at an early age Indeed, when the family moved to Port Huron, Mich, he set to work to read all the books in the public library, but he had the good sense to stop before very long

AMERICA S WIZARD OF INVENTIONS

At ten years of age his favorite study was chemistry One of his earliest experiments was to try to make a boy fly by giving him a huge dose of Seidlitz powders, expecting that the gases generated would make him light enough to float in the air!

To earn pocket money to stock his growing laboratory, Edison took a job at 12 as a train boy His two runs a day gave him plenty of time for chemical experiments, and all went well until one day a stick of phosphorus started a fire in the crude laboratory he had set up in the baggage car The conductor threw the boy and his equipment out, and Edison s railroading days came to an end

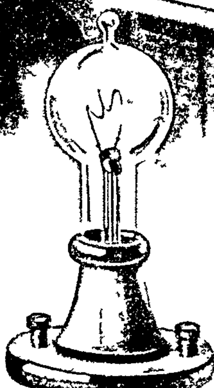
An accident at about this same time began the deafness which afflicted the rest of his life But Edison refused to be downcast, and often said that deafness had been a blessing in disguise to him, because it had relieved him of many distractions

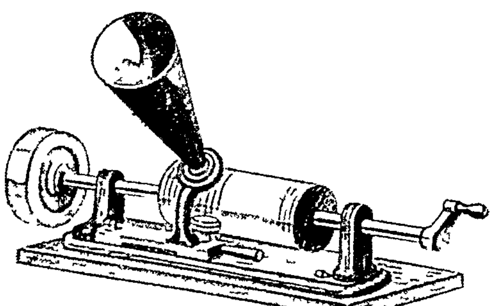
In saving the life of a station agent s baby the lad won a friend who taught him the trade of telegraph operator He soon became skilful in sending and taking messages and at 15 he was in charge of an office But he was determined to know how the instrument worked and why, and experimented with an old battery in his father's cellar until he understood it

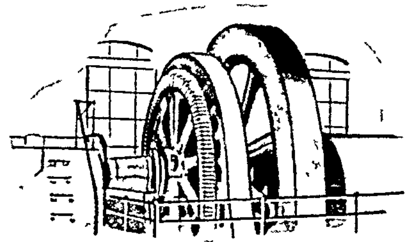
One of Edison's first inventions was a telegraph repeater, which automatically relayed a message to a second line The second instrument was arranged to work at a slower rate than the first, so that he could copy down dispatches which came too fast for him to take This device was the germ from which some of his later important inventions developed—notably the phonograph But all it earned him at the time was a reprimand from the manager of the telegraph office

The young Edison dressed shabbily and spent all he earned on books and apparatus He was thought to be an impractical dreamy young fellow, and his employers were often impatient For five years he led a wandering life as a 'tramp operator," often out of a job but working hard on his ideas for inventions. His notion of fun was to be so absorbed that he didn't know if it were night or day 'I owe my success,' he often said,' to the fact that I never had a clock in my workroom" He also said that "genius is 2 per cent *inspiration* and 98 per cent *perspiration*"

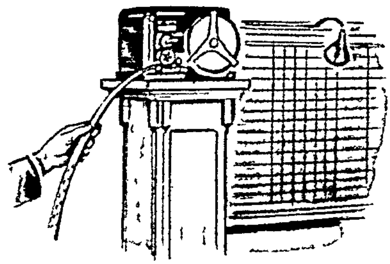
At 21 Edison devised a "stock quotation" printing apparatus For this and other inventions useful in



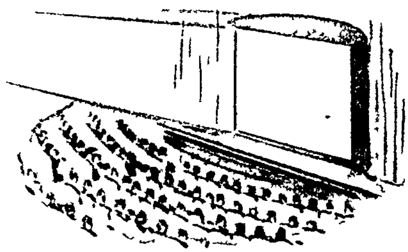




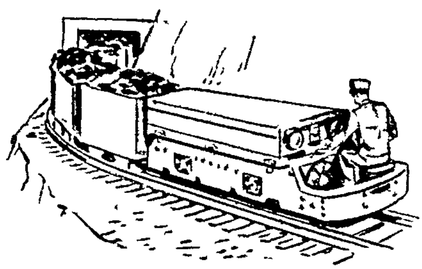
Edison was the first person to demonstrate that electricity could be generated in a central plant and distributed to an entire city.



A development of Edison's early experiments in telegraphy was the stock ticker that instantaneously records market quotations sent by wire



The millions who enjoy "movies" are indebted to Edison He greatly aided the industry with his technical work and his organizing ability.



The Edison storage battery is used to drive sturdy mine locomotives Though less powerful, it is lighter than the common storage battery.

The impress of Edison's inventions spread far and wide. Above we see him examining the first electric miner's lamp made possible by the lightweight Edison storage battery. Next, is a model of his most important invention, the incandescent electric lamp with carbon filament. At the bottom is a model of his first phonograph. The record of tin foil was turned by hand

broker s offices he got $40 000 With this money the young genius started a laboratory and factory in Newark N J It was the most remarkable establishment in the world where the 300 employees worked from sheer enthusiasm Here Edison coined his inventive brains into money He had 50 inventions at various stages at one time But before he was 30 his health failed and he gave up his factory for a laboratory at Menlo Park N J where he devoted his time entirely to invention

A big workshop and a small house suited Edison exactly He went about in shabby work-clothes and with acid stained hands Most of the time his wife and children dined alone for the Wizard ate when he was hungry and rested when he was tired—working 18 and 19 hours a day as a rule—and had as much fun in his work as a boy at a ball game

TWO WIZARDS OF ELECTRICITY

Edison s here examining the results of an experiment by Cha es P S e nmetz Both these men were gen uses n dev s ng new ways for the p act cal application of electric ty

Not all of his inventions were made easily Some he worked on for years and spent thousands of dollars in perfecting One rule he always kept Be sure a thing is needed or wanted then go ahead

On Oct 21 1879 Edison introduced the modern age of light In his laboratory at Menlo Park the young man tensely watched a charred cotton thread glow for 40 hours in an exhausted glass bulb He knew then that he had invented the first commercially practical incandescent electric light after spending $40 000 on experiments But this was only the beginning He must search the earth at great expen e for a filament which would burn for many days (*See* Electric Light and Power) He had to improve the dynamo to furnish the necessary power he had to develop a complete system of distributing the current and he had to build a central power station

Fifty years later in October 1929 American leaders paid tribute to the great inventor on Light s Golden Jubilee Overseas came the voice of the German sc entist Einstein The speeches were borne to millions by radio Cit es were brilliantly lighted A jubilee stamp was issued The setting for the event was the permanent birthplace of light created by Henry Ford at Dearborn Mich near the Ed son School of Technology Here Ford moved the or ginal Menlo Park laboratory and the very railroad station where the newsboy Edison was dumped after he set fire to a car with his chemicals

Edison outgrew his Menlo Park laboratory in 1886 and moved to an immense plant at Orange N J His major inventions were the incandescent electr c light the phonograph motion pictures automatic and multiplex telegraphy the carbon telephone transmitter a stock ticker the alkaline storage battery and the microphone He also helped transform modern life in scores of other ways The great electrical expert Charles Proteus Ste nmetz was quoted as saying that Edison had done more than any other man to promote electrical engineering He improved methods of concentrating iron ore and made improvements in the manufacture of portland cement During the first World War he concentrated on naval problems and the production of chemicals After 1927 he experimented to produce rubber from plants and bushes grown in the United States When his last illness kept him from his laboratory he directed these experiments from his bed Shortly before his death his son Charles and other a sistants brought him four samples of goldenrod rubber—the last fruits of his genius

Edison died on Oct 18 1931 and was bur ed at Orange Honors had come to him until he could count his medals by the quart as he once jokingly said He had degrees from many famous universities Wealth poured in from his hundreds of inventions The great industries based on them yielded fortunes for many people and produced b llions of dollars in dividends *sala ies and wages.*

One secret of Edison s success was his unlimited patience His powerful imagination his firm optimism and his complete self-confidence also helped to d stinguish him from ordinary men

Edmonton Alberta The capital and largest city of Alberta lies on the North Saskatchewan River almost in the geographical center of the province It is one of the largest a r freight shipping centers on the cont nent and the starting point for passenger flights to the Northwest Territories Yukon Alaska and the Orient At Cooking Lake 15 miles distant is a base for seaplanes which use the northern lakes as landing fields Edmonton also serves the Canadian northwest by motor truck over the Alaska Highway by rail and highway to Peace River and to the end of steel at Waterways and thence by boat down the Mackenzie River system

The city is the marketing center of the rich dairying and mixed farming region of central Alberta Near by is the great Leduc oil field brought into product on in 1947 Coal and natural gas are abundant The industr es include meat packing flour mills railway repair shops an o l refinery and woolen and garment factories Edmonton is the seat of the University of Alberta Population (1951 census) 159 631

Trips to the park with mother help get children ready for school. These children are learning many things that create lively interest in the world about them.

EDUCATION—
For All the Children of All the People

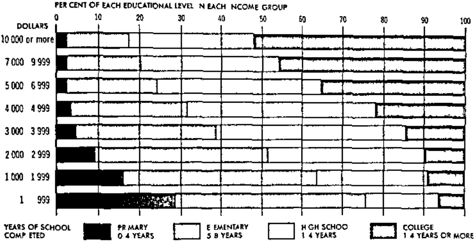
EDUCATION. Of all living things only man has developed a means of passing on his learning—values, skills, and attitudes—to new generations. This process is called education. Learning takes place throughout the entire life span of man. The speed with which people learn changes with age, subject matter, method, background, attitudes, interest, and many other factors.

Many people think only of schoolwork when they speak of education. More true education, however, comes from outside the school program than from within it. It is in ordinary family situations that the child learns his basic skills, attitudes, and values. These range from the skills involved in eating, dressing, walking, and talking to moral values, religious

INFORMAL AND FORMAL LEARNING

This boy (left) is learning "man's work"—the use of hand tools—from father. They are making a toy train. In this biology laboratory (right), students who have had several years of formal schooling now work independently.

Relationship Between Education Level and Income



This chart shows that it pays to stay in school The bars indicate the percentage of men at various income levels with primary elementary high school and college education Of those who earned $10 000 or more more than 80 per cent had college or high school training Of those who made less than $1 000 75 per cent had quit school in an elementary grade

attitudes sharing with others love of fellow man and respect for law Upon these fundamentals future success and satisfaction often depend Upon such things rests the rich heritage of human life

Learning from Parents and Family

Every worthy parent has amb tions for the future of his children Many are inclined to underest mate the educational value of the home and family in preparing for this future Yet it is in the home the neighborhood and the commun ty that the most effective and lasting education takes place Values attitudes habits and skills learned by taking part in family life retain a firm hold on the entire life of the person Whatever is learned—be it good or bad—is not easily put aside Truly the parent has a great respons bility for the future of his children

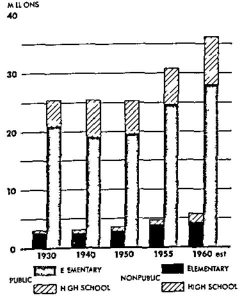
Patient loving care of a helpless infant k ndly consistent interest and understanding of childhood problems wise and thoughtful widening of children s experiences with new places new friends and new events the stimulating introduction to the wonderful imaginative world of children s literature accurately satisfying chil lren s countless questions encourag ng an ever increasing active interest in the events of the world—all these are part of the privilege of parenthood These practices provide the basic informal educat on on which the more formal schooling may later build to produce at maturity an independent well adjusted citizen (*See also* Child Development Family)

Many Agencies Aid in Education

The family does not stand alone in educating its ch ldren An almost endless number of agencies share in the process both formally and informally The

Growth of School Enrollment

PUBLIC AND NONPUBL C



Here we see that attendance in public and private schools has surged upward since 1930 and a further rise is predicted for 1960 The charts in this article are based on graphing of federal data by the Chamber of Commerce of the United States

OPENING THE DOOR TO LEARNING

This mother is getting her little girl ready to learn rapidly in school. By using the encyclopedia with the child, she creates interest, builds vocabulary, and answers questions while the child's interest is high.

church has always played a significant role in the establishment of ideals and morals, in teaching co-operation with one's fellow man, and in giving meaning to life. The school, by established courses of study, has long devoted itself to teaching children the needed skills for a successful life. Patriotic societies, youth organizations, private foundations, social agencies, museums, industrial and labor organizations, lodges, and numerous government agencies develop programs to foster education at various levels. Newspapers, magazines, radio, and television also provide educational programs. (Articles on many of these agencies can be found through the Fact-Index.)

Because of the vast number of agencies and individuals taking part in the education of each child there is a need for their efforts to be co-ordinated. The family has the strongest interest in the child. It is the least changing of all the educative agencies. The family members and ideals usually remain the same or almost so. Thus it is the family's responsibility to co-ordinate the education of its members.

This task is not an easy one. The family, in this country at least, is free to choose its church and some other agencies whose programs agree with its ideals. The family is usually obligated to accept the program of the public school because education is compulsory in every state. The family role is one of co-operation with the schools. This means preparing the child for his school experiences, working with the school on current problems, and encouraging the child to make the best use of the school's facilities. Each of these tasks requires thoughtful planning and continuous effort on the part of parents.

Family Help in School Success

School success frequently depends upon the home. First there is the matter of readiness for school. This implies preschool experiences in a wide and meaningful pattern. Play experience with other children; trips to places of child interest such as stores, parks, travel terminals, and places of work; many stories read and told; experiences that involve number, size, shapes, money, construction, running, throwing, singing, and talking—all these build a useful background for the child when he goes to school. Such experiences need to be normal and recurring events of preschool life and not something crowded into a few days or weeks.

No one family can expect the school to conform wholly to its ideas. Our public schools were established for all the children of all the people. It is the responsibility of parents to understand the purposes and programs of the school and to give it, in turn, an opportunity to understand the family. It is also the responsibility of the

RELIGIOUS TRAINING IN A CHURCH SCHOOL

The church is important to a well-rounded education. In Sunday school and other church groups, children are given instruction in religion, in moral and ethical principles, and in social attitudes.

family to assist the school in achieving its purposes

Whether or not the family is in full agreement it should understand and must finally accept the school's method of teaching to avoid confusing the child. It should encourage a high level of school performance. It can help do this by providing suitable space and aids for study. The home and family may further provide opportunities for experiences of many sorts and encourage the child to take part in educational activities. Parents should permit experimenting, constructing, and collecting on the level of the child's development. They should foster interest in reading, develop care in speaking, listening, and viewing, and encourage self help on the part of the child. These are the roads to school success *and success in later life. Ways in which the* parent can help his children learn are *described in many articles in this encyclopedia* (*See* Study, Nature Study, Social Studies, Language Arts, Reading, Arithmetic; *see also* the Reference-Outline at the end of this article.)

A MOTHER AND A TEACHER CONFER

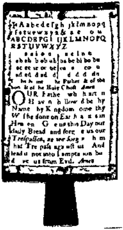
This mother is learning about the school program so she can assist her children more intelligently. Mother and teacher both understand the children better after such conferences.

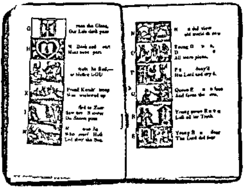
Differing Views on School Programs

As a nation Americans have long agreed that it is in the public interest for children to be given formal education at public expense. We have also agreed that public education should be responsive to the needs and desires of the community. At the same time there has been a growing belief that regardless of the local desires such larger community units as the city, the county, the state, and the nation also have a stake in our children. To some extent therefore these larger units also influence education.

In a free society such as ours a high value is placed on individuals and their opinions. We accept no one authority as final in educational matters. Parents and communities value events and skills differently and also have changing standards of acceptable behavior and attainment. Each family in a community willingly delegates the responsibility for some elements of education to the schools and churches (but retains responsibility for other elements). There are wide differences between families regarding the elements they wish to control themselves and those they are willing to delegate.

Even when there is community agreement on the general function of the locally supported school there may remain wide differences of opinion about the methods of teaching and the standards of achievement





A HORNBOOK AND A NEW ENGLAND PRIMER USED BY *COLONIAL PUPILS*

The religious motive in colonial education is shown in the text books of the period. A beginner studied the alphabet and the Lord's Prayer from his hornbook. The text mounted on a small board with a handle was protected by a sheet of horn. The New England Primer—popular for 150 years—featured rhymes about Biblical characters illustrated by woodcuts.

This is proper and to be expected in a free society.

Despite disagreements and real or imagined faults found with the schools, few among us propose the abandonment of the public school idea. We may want to change the emphasis, to criticize the method or cost, or to alter some particular phase of the school system or program, but we are agreed as to the useful role the school plays in our common life.

Goals of Education

EDUCATION would be haphazard were no formal schemes devised by adults to pass on to the young what adults know and what they value. It is through education, formal and informal, that the young person comes to know what his society cherishes. By means of education the young are prepared to take part in the perpetuation and further development of this knowledge and of these ideals. This was true at the dawn of history and it is true for modern man.

In the United States the public schools are the creation of the people and they must serve all the children of all the people. The general purpose is to prepare the young for participation in a life of citizenship in which all may share equally (*see* Citizenship). Our devotion to the equalization of educational opportunity for all was made clear in the decision of the United States Supreme Court of May 17, 1954, which found that racial segregation in the public schools was unlawful.

America's democratic purpose stands in sharp contrast to the concept of education held by totalitarian governments, who use schools as they use all other institutions—to create tools of the state rather than free citizens. George S. Counts and Nucia P. Lodge, through translations of Russian writings, revealed that the purpose of the elementary schools under Stalin was to promote love of the motherland, reverence for Stalin, and hatred for the enemies of both.

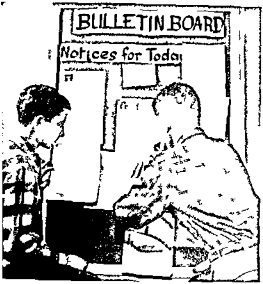
The American purpose is also in contrast with the aim in many older systems in Europe. There schooling for the mass of children is limited to a few years, while a select group receives extensive special training for leadership. The two classes tend to move apart in this "two-track" system.

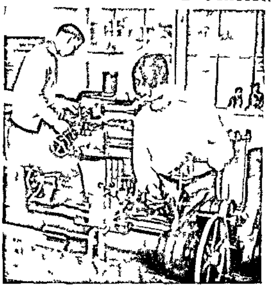
Religious Motive Starts School Growth

American education was organized to serve the needs of the people and has always been sensitive to these needs. American common (elementary) schools were started in the colonial period to teach reading so as to permit religious indoctrination. Legislation in Massachusetts in 1642 required that children be taught "to read and understand the principles of religion and the capital laws of the country." No schools were established at this time but in 1647 the legislature required (1) each town of 50 householders to make specific provision for the teaching of reading and writing, and (2) each town of 100 families to establish a grammar school.

Secondary education, though not provided everywhere, was started equally early. A Latin grammar school was begun in Boston in 1635. Its purpose was to provide the student with the Latin background he would need for college work. Later, private schools and academies, though not free, included more practical subjects. They paved the way for the public high school, which had its start in Boston in 1821. The high school was not welcomed by all citizens, and its right to tax support was challenged. A decision by the Supreme Court of Michigan in 1874, in the famous *Kalamazoo*

A PIONEER AMERICAN SCHOOL
In this old painting one class stands to recite while other pupils sit on the backless benches studying or figuring on their slates. Children facing the wall have a slanting shelf for a desk. Whispering seems common in spite of the master's stick.

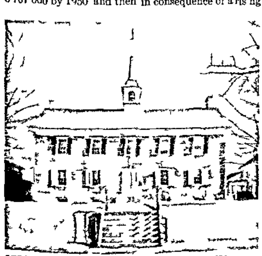




EDUCATION FOR CITIZENSHIP AND TRAINING FOR A VOCATION
These high school boys signing a petition (left) are practicing one of the rights of citizens in a democracy. These lads doing lathe work in a school metal shop (right) are receiving training for their chosen occupations.

case paved the way for the extension of the public high school. The court rejected the claim that the state should not support secondary education.

With the legal road cleared, the response of the citizens was dramatic. In 1870 there were approximately 0 000 students in public high schools. By 1900 the enrollment exceeded half a million; by 1930, 4¼ million. Enrollment had doubled each decade. Attendance reached a peak of 6,601,000 in 1940. It dropped off somewhat during World War II, climbed to 5,707,000 by 1950, and then, in consequence of a rising



GERMANTOWN ACADEMY IN PHILADELPHIA
Founded in 1760, this is the country's oldest school which has had continuous existence in the same building. First called the Union School, it had German and English masters. The building was offered as a meeting place for Congress in 1793.

birth rate during and following the war, moved upward again. In the first half of the 1950's the approximate total enrollment in elementary and secondary schools reached more than 30 million. An enrollment of more than 41 million is predicted by 1965. Meanwhile American college education, which started with the establishment of Harvard in 1636, developed comparably, enrolling more than 2,600,000 students by 1950.

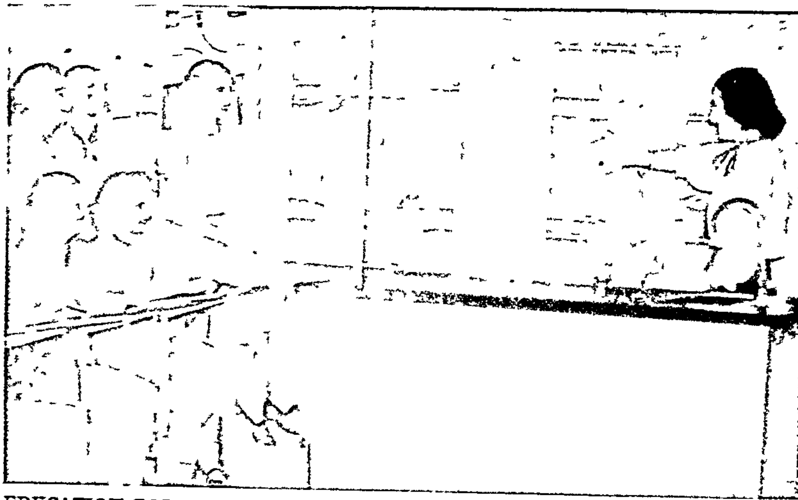
Varied Goals and Achievements

The rapid growth of American education in response to the needs of a developing country has led it to accept a variety of purposes, from college preparation to preparation for the safe driving of automobiles; from cultural or general courses to those specifically vocational.

Soon after the founding of our government, the chief goal of education became the preparation of citizens for the duties and responsibilities of self-government. Suffrage was limited at first. As the right to vote and hold office was extended, the expansion of the free public school followed.

As a flood of immigrants swelled the new land's population, the schools, by teaching the children of the newcomers our language, ways, and ideals, carried on the work of Americanization and assimilation. When pioneer settlers moved the frontier westward, they proudly built schoolhouses amid their new cabins. The schools took on another unification task—tying the old settlements to the new. In these ways the *schools helped the vast new country to develop and share a single culture.*

Growing commerce and industry demanded able workers, and the schools, responsive as always to the needs of the people, accepted responsibility for a new



EDUCATION FOR MODERN LIVING
Safe driving has become an important skill of everyday life for Americans. These high-school girls are learning the traffic laws as part of their drivers' education.

and expanding problem. In the 18th century the idea that a working man needed to know the "three R's" seemed a radical one. As the amount of schooling required for economic competence has increased over the years, the schools have been asked to provide specific vocational training. To further aid industrial advancement, the universities multiplied research activities in scientific and technical fields. America's industrial leadership could not have been attained without the discoveries made in the research laboratories of our universities and without the development by our public schools of a skilled and literate labor force. (*See also* Industry, American; Vocations.)

Readiness for Living

The complexity of modern life has also brought new objectives to education. Know-how is needed to cope with today's transportation, communication, trade, and everyday living. With more than three fifths of the people living in towns and cities, the "difficult art of getting along with others" has become a first essential. The schools in recent decades have assumed the task of teaching co-operation—of helping individuals become happy, responsible, and productive members of the community.

Where education was once selective above the first years of common school, it now tries to serve all the children. These children come to school for a variety of reasons, and they come from a variety of family backgrounds. In Cleveland, Ohio, for instance, 45 national groups are represented in the population. Each group, through churches, social and fraternal clubs, newspapers, and the like, has its own educational program to perpetuate its own cultural values; yet all share in the program of the public schools.

America's leading position within the world of nations has forced it to shift its educational sights to more distant horizons. Through the United Nations and various regional organizations, its people have joined with other peace-loving peoples of the world to protect and extend the heritage of free men wherever they are.

The Educative Process

WHAT GOES on in the classroom (educational method) is shaped by the view of learning held in the school system. Boyd H. Bode contended that a troublesome source of confusion in the educational process was that all the views of learning ever held by man are still to be found in classroom practices. It is also a reason why parents misunderstand some of the classroom procedures their children are using.

At first glance to laymen at least, the educative process seems simple enough. A teacher who knows something tells a child. The child, by observation, memory, reason, and other mental powers, thus gains the knowledge for himself. He learns. This view has substantial historical backing and, in addition, common sense appears to confirm it. Learning does occur through experience. School learning occurs through the experiences the teacher arranges. (*See also* Learning; Memory; Study.)

Yet the matter is not simple. Many children (and adults too) can do what they have been told to do without understanding the meaning of what they do. Such learning is passive and involves only rote memory. Though many people (including some teachers) identify this as learning, modern education does not.

In a modern school the educative process engages the students in activity. This is not because activity is prized for its own sake. It is because true learning (including understanding) comes about only through one's own active participation in learning situations. A child is no longer thought to be a mere passive receiver, to be filled as a sack may be filled. William Heard Kilpatrick has said that we learn what we live and in the degree that we accept it to live by. This involves the whole person—how he acts, how he feels, how he thinks. It involves a shift in educational emphasis from subject matter to the whole child. "We teach children, not subjects."

Historic Views of the Mind

From the 17th century on, a theory known as "dualism" has been prominent in educational thought. This theory separated *mind* and *body*, endowed the mind

with certain faculties or powers and made the development of these faculties the central task of education Although the mind was held to be immaterial in contrast to a material body René Descartes a French philosopher of the 17th century *placed it in the pineal gland The mind was thought* to work best when free from the disturbances of an active *body* *This* conclusion meant that children learned best when quiet and attentive

The way to improve the mind according to this view was to improve its faculties This was to be done through exercise in the same manner in which muscles are developed A boxer strengthens his legs by running a child so it was thought could strengthen his faculty of reasoning by studying mental arithmetic or his memory by studying history Since a boxer could gain the same end by skipping rope or by taking long hikes some people thought it made no difference what the child studied so long as it was difficult This view of mind is still widely held today though it is no longer believed by modern psychologists (*See also* Mind Brain)

John Locke advanced another theory of mind (*see* Locke John) He called it a *tabula rasa* a blank tablet on which experience so to speak could write This view gave an educational use to the body since the content of the mind (the tablet) came from the operation of bodily parts The first words in his essay Some Thoughts Concerning Education were A sound mind in a sound body His first consideration was health This emphasis has remained in education His opening phrase has become a popular slogan

How the Senses Contribute to Learning

Locke s position was successfully challenged by two British philosophers Bishop George Berkeley and David Hume They held that Locke s theory reduced all experience to fleeting mental states since the content of a blank tablet mind could only be the passing impressions given it through (or by) the senses Nevertheless the notion that the bodily senses contributed to education brought a change in the conception of the nature of the educative process

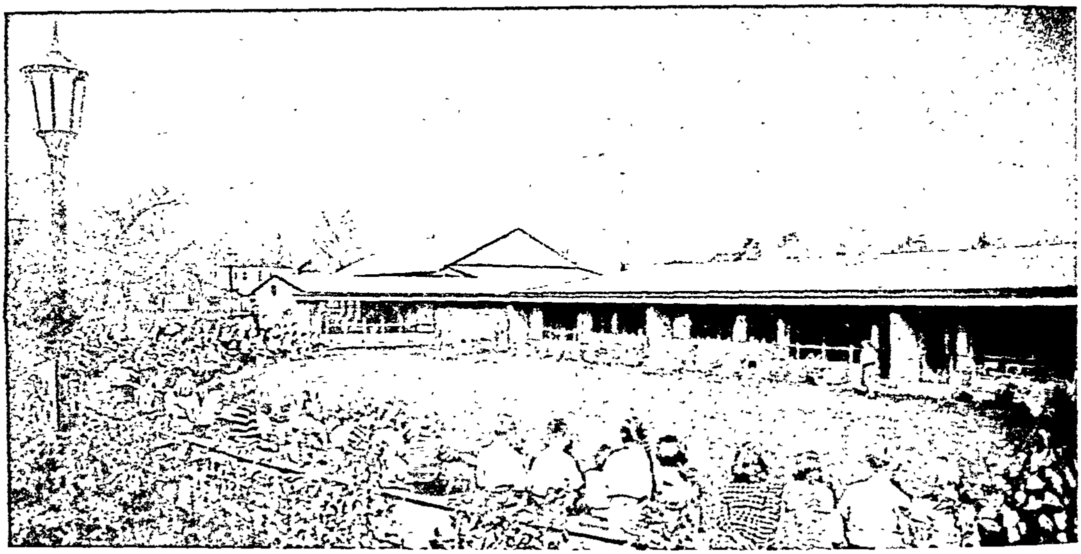
This point of view was furthered by Johann Heinrich Pestalozzi the great Swiss educational reformer and Friedrich Wilhelm Froebel the German educator Each of them emphasized the senses and activity of the child as sources of and aid to education The influence of these men was felt in the development of American education especially in the elementary schools Froebel was important to pre school education where his conception of kindergarten *took hold* (*see* Froebel Kindergartens and Nursery Schools)

Johann Friedrich Herbart an early 19th century German educational philosopher provided still another influence He suggested an educative process in which the organization of ideas by the student would build a widened range of interests This led to much outlining precise writing and formal organization *In the hands of many who thought they were* following Herbart s ideas teaching methods became routine and uninspired

The Doctrine of Transfer of Training

A second challenge to the mind and body dualism came from the experimental pyschologists The dualistic views led to some form of formal discipline as *the teaching method Men who held this view also be*lieved that training attained by exercise of a faculty in one situation would have direct value in other unrelated situations which used that faculty This was the doctrine of transfer of training It

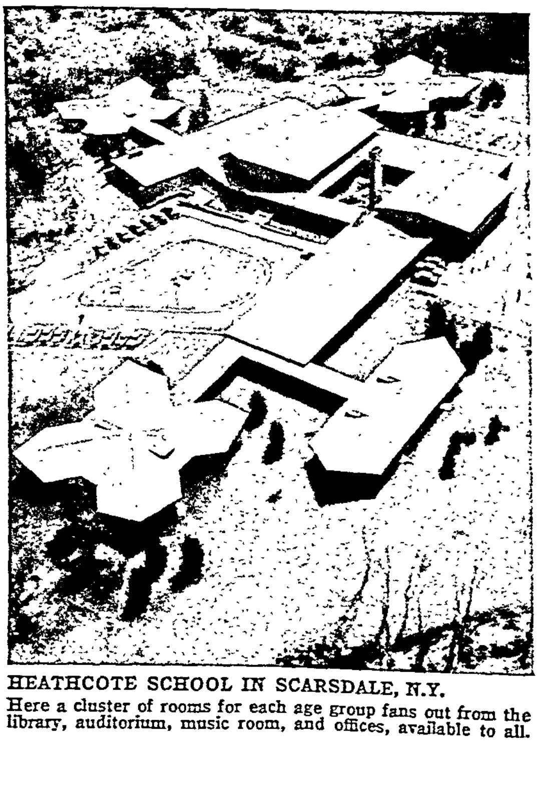
LEARNING THROUGH ACTIVITY IN A KINDERGARTEN
These children are active in a variety of learning experiences in their sunny well planned room at the Ralph R Smith School Hyde Park N Y Small furniture is shifted for shared tasks Notice the room s outer door the low sink and the storage bins



A BUILDING FOR SCHOOL AND COMMUNITY
This attractive school sits amid the trees of Blythe Park, in Riverside, Ill. Community gatherings use this amphitheater in summer and the auditorium-gymnasium wing in winter.

was challenged by experiments on memory improvement by the psychologist William James. His work set off a chain of experimental work which seemed to show that the idea of transfer of training was wrong. Yet no one can deny that man does solve new problems by using what he already knows. This fact needed to be explained and used.

Three 20th-century educational leaders contributed theories. Charles H. Judd suggested that transfer depended upon the development of general ideas in specific learning situations. Edward Lee Thorndike maintained that identical elements in new and old situations accounted for transfer. Boyd H. Bode held that transfer takes place when old meanings help an individual find his way in a new situation. All three denied the theory of exercising the faculties of a mind separate from the body. All put emphasis upon teaching with a view of making transfer possible. All placed more emphasis upon an active student.



HEATHCOTE SCHOOL IN SCARSDALE, N.Y.
Here a cluster of rooms for each age group fans out from the library, auditorium, music room, and offices, available to all.

Behaviorism and Educational Measurement

The educative process was also influenced in another direction by the development of *behaviorism* in psychology. John Broadus Watson, Albert P. Weiss, and Max F. Meyer were prominent in advancing behaviorism. They studied behavior, in simple and even complex forms, by observing it. To explain behavior they found no need to talk about a mind. Their problem was to discover what stimulus caused a particular response and what responses were appropriate to particular stimuli. The purpose of the educative process (method) was to connect the stimuli selected (the curriculum) by the teacher with the desired responses (the educational product).

Thorndike, though not a behaviorist formally, supported the position through the laws of learning he formulated. These laws were: the law of readiness, the law of exercise, and the law of effect. They greatly affected the educative process in American schools.

Teaching became more specific, with its results more directly observable. The development of educational measuring and testing devices was accelerated. Standards for grade and age progress in various school subjects were established. Objective examinations replaced the essay type; and a certain mechanical

efficiency characterized the educative process, with drill and habit formation emphasized

During the 1920 s especially, Thorndike, the psychologist and John Dewey, the philosopher with totally different ideas of the educative process left a deep imprint upon American education Few educators were aware of the basic conflict in their positions Dewey rejected the theory back of Thorndike s stimulus responses connectionism in 1896 More than a quarter of a century passed before developments in psychology supported Dewey

Educating the Whole Person

Kurt Koffka, in 1924 and Wolfgang Kohler in 1925 advanced the *Gestalt* theory which emphasized the unity and wholeness of behavior in contrast to the specific and part-by-part approach of behaviorism American psychologists following this lead from Germany, developed the *organismic* position in psychology which recognized the whole of behavior to be more than the sum of its parts Prominent advocates of this theory were Raymond H Wheeler, Karl S Lashley Kurt Lewin and Robert M Ogden Under it education moved away from an excess of mechanics and detail to a consideration of the effect of the educational environment as a whole upon the student as a whole person (*See also* Psychology)

Educational Theories of Today

The educative process today is still influenced by its own past New ideas do not supplant old ones they emerge from the old and reshape them Present practices foreshadow the direction of likely future developments in the educative process Current theories assume an active rather than a passive student The interests needs and problems of the student are accepted as an important means of getting him to understand the interests needs and problems of his society The meaning and application of facts not the facts themselves are teaching goals

The ability of the student to think (and where necessary to think as a member of a group) is recognized as the way to develop self-discipline Knowledge is viewed in terms of its many uses by the individual not as a collection of specific and unrelated items The central purpose of the school is *to develop individuals who are experienced in the values and ways of democratic living*

How School Buildings Have Changed

Changed conceptions of the educative process have influenced more than the work that goes on within the classroom The idea of the school building itself has changed The newer building is no longer merely a *structure in which learning takes place* It is as much a part of the learning situation as are the books the teachers and the students Rows of desks have been replaced by movable tables and chairs Single windows have given way to walls of glass or of glass block To break the monotony of drab walls color has been introduced by the use of tiles and paint and colored chalk boards Rooms and halls have been acoustically treated to reduce noise Fireproof construction has become general

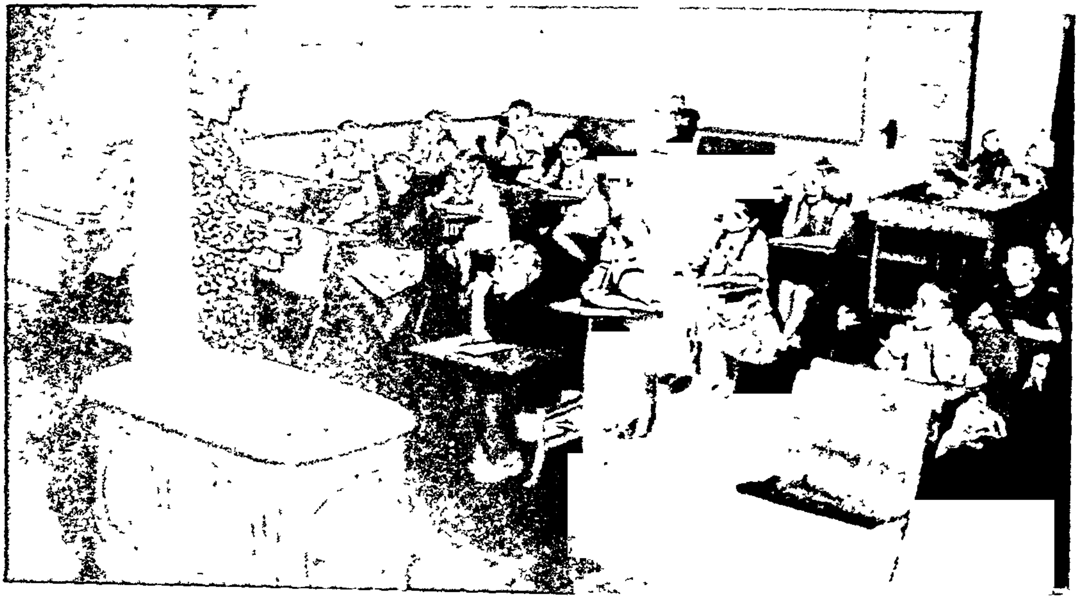
Many new school buildings are planned so that units may be added attached to the older units by covered walkways or corridors Clusters of rooms for kindergarten or primary children are set apart from the classrooms of older pupils Patios and grass plots permit classes to be held outdoors The auditorium and the gymnasium the cafeteria and the shops the library and the art rooms are designed to encourage active and flexible life within the school

STUDYING A FROG S ANATOMY

This anatomy model is an example of modern instructional materials Such aids provide concrete visual experiences for pupils in all grades

LEARNING MANNERS THROUGH TELEVISION

Since proper social behavior is a problem that concerns young people the program How s Your Social I Q ? on WPTZ in Philadelphia was a popular school feature Students took part in producing it Here high school seniors are leaving for a prom and the boy helps the girl with her wrap



THE SCHOOL MANY PARENTS REMEMBER
Generations of pupils have attended schools like this one in rural Maine. Every child is expected to sit quietly and pay attention to books or teacher. Such schools are fast disappearing.

Modern school sites provide adequate play space and are selected to permit future expansion. Their location is a first thought in community planning.

Improvements in Learning Tools

Improvements also have been made in all the materials of instruction that affect the work of the school. Books are more attractive, especially the books used in the elementary school. The type, the page make-up, frequently in two-column form with attractive pictures and diagrams (often in color), combine to induce children to use books. The selection of content is in terms of known interests and needs of the grade for which it is prepared. The vocabulary and concepts are controlled to reduce reading difficulty. All these factors make modern textbooks very useful educational instruments. These changes are equally evident in encyclopedias, children's literature, and supplementary materials being developed for school use (*see* Reference Books).

With the trend away from the single text and toward a variety of source materials, the school library has come into general use. Home-room and self-contained classroom libraries are provided to make resource materials immediately available. Such libraries contain reference volumes and supplementary books likely to be in daily demand. They also borrow collections from the main library to meet special research needs. (*See also* Libraries, section "School Libraries in Modern Education.")

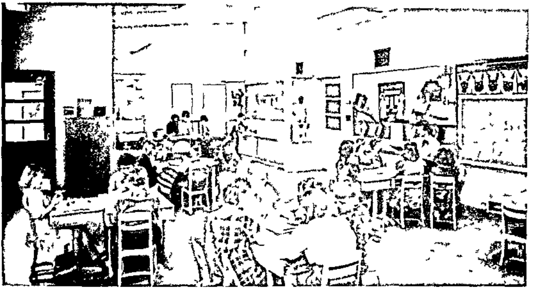
Audio-visual instruction has brought into the schools a variety of attractive and helpful teaching and learning tools. They include such visual aids as films, filmstrips and slides, maps, graphs, charts, pictures, and models; and audio and multisensory aids, such as radio, record players, tape recorders, and television, together with manipulative devices. Their purpose is to promote learning by all available means; they are not devices for child entertainment.

Modern School Practice

MEMORIES of their own school days make it difficult for many parents to understand and co-operate with the schools their children attend. Parents recall an orderly classroom with seats bolted to the floor row by row. Teachers took pride in keeping children quiet and orderly. They gave assignments mainly from a single textbook, held recitations, and gave tests to see how much of the material the pupils had mastered. All the children worked at the same task at the same time and each worked alone. There were lists of words to be learned, mathematical tables and rules to be mastered, reading skills and writing mechanics to be acquired through drill, and facts to be memorized in history, geography, civics, science, and the like. Each month a report card went home to show parents, in percentage form, what the child had done.

At the end of the year those pupils whose grades were not up to standard received a "failing" mark and were required to remain in the grade and repeat the subjects another term. Mastery of subject matter and skills—sometimes called the "three R's"—was the goal.

Parents who attended "traditional" schools are often puzzled by the modern schools, especially those called "progressive." Gone is the quiet classroom with every child assigned the same task. Pupils have freedom to talk and work together in committees. Ac-



A FLEXIBLE MODERN SCHOOLROOM

Here pupils work together on their projects The teacher joins in the activity of one group A counter and sink provide work space for experiments Pupil art and collections are displayed.

tivities, planned through pupil teacher co-operation are designed to create interest and provide learning experiences The teacher recognizes a wide range of individual differences among the pupils judging and grading a child's achievements according to his capacities, maturity, and efforts The report card may carry a brief essay on his progress rather than a definite mark "Failures" are rare Many schools have a policy of "social promotions" permitting children to progress from grade to grade with their class

Fundamental skills and information in familiar subject-matter fields are still among the chief goals of the modern schools but they do not receive the sole emphasis they once did Increasing emphasis is placed on the social skills involved in democratic living and on the personal development of the individual

Wide Objectives of Today's School

The wider goals of the modern school are discussed in 'Elementary School Objectives, by Nolan C Kearney, brought out in 1953 by the Russell Sage Foundation It reports the work of the Mid Century Committee on Outcomes in Elementary Education

In setting forth the outcomes "important enough to warrant direct effort on the part of the school and the teacher," the following areas of learning were listed (1) physical development health body care (2) individual social and emotional development (3) ethical behavior standards and values (4) social relations, (5) the social world (social studies), (6) the physical world, (7) aesthetic development (art music the crafts), (8) communication (reading writing composition correct usage, spelling, punctuation, speaking, listening reference skills), and (9) quantitative relationships (numbers arithmetic)

Desired outcomes in each of these learning areas were classified under these headings (1) knowledge and understanding (2) skill and competence (3) attitude and interest, and (4) action pattern Goals were suggested in each category to show growth at the end of the primary elementary and upper grades (For discussion of various subject-matter fields *see also* Reading Writing Spelling Language Arts, Arithmetic Social Studies Geography History, Arts The Citizenship Home Economics)

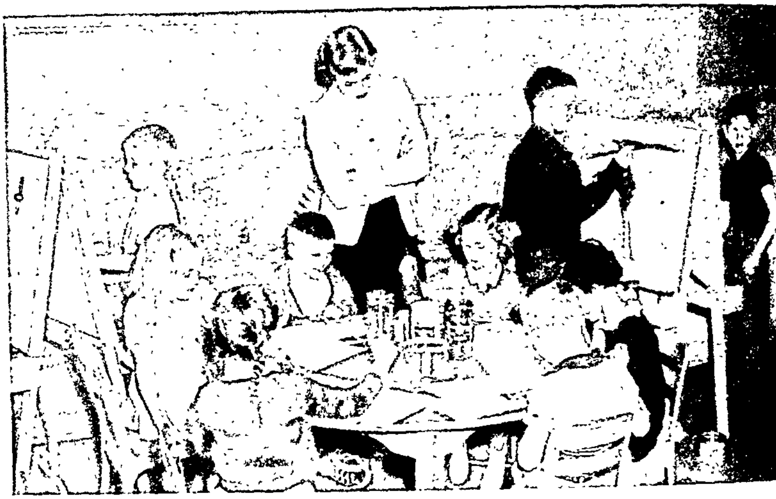
Reasons for Change

Parents also have some difficulty in making sense out of the educational discussions they encounter The progressive finds present educational practices hopelessly traditional the conservative is certain that they are wildly radical Each faction admits change—but some wish to hasten it and others believe it has already gone too far Modern educators hold that change has taken place with one end in view *to create an improved environment for learning* The replacement of the fixed desk by movable furniture was not done to permit the child to run wild in the classroom This change took place in order to free the child to learn through the purposeful activity in which he may engage and through which he may share his activities with others The field trip was not introduced to relieve the student from the boredom of a classroom The trips were arranged to enable him to discover for himself materials that related to topics or problems he was studying or conversely to help him recognize topics or problems for study

It is unlikely that any single school will be representative of a single point of view or of a single set of practices What is done in the school however clearly shows the attitude of the school with

regard to change. This change may be roughly described as moving from a *subject-centered* school to a *child-centered* school to a *society-centered* school to a *value-centered* school.

The traditional school *emphasized* subject matter. It was not insensitive to children; it was simply not aware of what the differences among children meant for learning. As the psychologists came to understand more about individual differences, especially as the testing of "intelligence" was advanced in the 1920's, changes were made in school practices that brought the individual to the fore (*see* Individual Differences; Intelligence Tests). One change put students of like ability (bright, average, dull) together. This movement was known as *homogeneous* grouping, the groups frequently being designated as "X," "Y," and "Z." Individual ability was recognized; but the purpose of the teaching continued to be subject-matter skills, each group mastering it at its own pace. Individuals differ in so many ways and for so many reasons, it was discovered that grouping on the one factor of intelligence did not meet the real problems of individual differences.



CREATIVE AND AESTHETIC EXPERIENCE
Here children are enjoying creative experiences in an art class in Perrysburg, Ohio. Today art activities help promote learning in virtually all fields of study.

Dalton and Winnetka Plans

Other movements that centered upon the individual, also in the 1920's, were known as the Dalton Plan and the Winnetka Plan. Helen Parkhurst, at Dalton, Mass., reorganized the elementary curriculum into a series of units or "contracts." As each child "accepted" his contracts he accepted the responsibility to complete a specified amount of work in a specified amount of time. The normal contract lasted for four weeks. During that time the child decided, in consultation with an adviser, what portion of the work he would spend his time on each day. Later, Miss Parkhurst started the Dalton schools (nursery through high school) in New York City.

Carleton Washburne, as superintendent of schools at Winnetka, Ill., provided a series of "goals" in each essential subject for the various grade levels. Students worked to master these goals at their own speed. Each of these schemes broke with tradition in terms of *method*. Neither resulted in a marked change in the dominance of *subject matter*. Yet each represented a transition stage toward the child-centered school that emerged in the 1930's.

William H. Kilpatrick, with his emphasis upon learning through activity and interest, was a leader in this movement. The interests, needs, and problems of the child, rather than subject matter, were thought to be the proper focus for the organization of the curriculum. This represented a widened concept of the curriculum, involving all the activities (experiences) of the children. It was from this view that the *project method* developed. In it the purpose of the learner directed the activity. Ellsworth Collings, in McDonald County, Mo., and others elsewhere experimented with the project method. They found that in schools where it was used students learned more of the traditional subject matter than those in schools where no change had been made.

Changes in the High-School Curriculum

Change is more readily achieved in the elementary school than in the secondary school. The secondary, or high, school has long been dominated by the re-

PLAYING 'THE MIKADO' IN HIGH SCHOOL
Production of an operetta is a time-honored method for developing social confidence as well as dramatic and musical talent

VISITING A TELEPHONE EXCHANGE
This class is learning how a switchboard works On field trips pupils gain firsthand experience with community resources

quirements of college preparation These requirements have largely determined high-school course offerings Where this is not the case, the desire of young people to prepare for work has led to the introduction of business courses and industrial trade training

By the end of the 19th century the high school curriculum began to pay more attention to the lives students would lead It expanded its course offerings beyond the college preparatory subjects The National Education Association appointed the Committee of Ten on Secondary School Subjects to evaluate the newer ideas found in curriculums President Charles William Eliot of Harvard University was appointed chairman of this committee in 1892 (*see* Eliot, Charles W) The committee concluded that all subjects had potential intellectual value if taught properly

FINDING SCIENCE ANSWERS FOR THEMSELVES
These students at Hirsch High School in Chicago Ill, are making tests to identify an unknown chemical compound.

and if studied long enough This report gave some support to those who wanted to extend the traditional curriculum It did not establish a purpose for American education beyond vaguely suggesting that all subjects should foster mental discipline

Cardinal Principles of Secondary Education

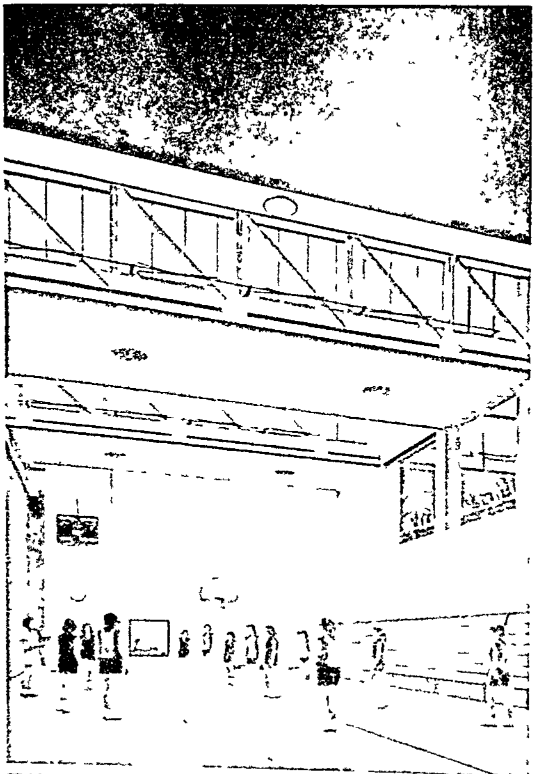
A 1918 committee of the National Education Association the Commission on Reorganization of Secondary Education proposed a set of *cardinal principles* which included unifying objectives for all the offerings of the high school These objectives were (1) health (2) command of fundamental processes, (3) worthy home membership (4) worthy use of leisure (5) vocation (6) citizenship and (7) ethical character All subjects were to emphasize all objectives though a natural relationship was recognized between certain subjects and certain objectives such as that between home economics and worthy home membership physical education and health and the like These proposals were very influential In time it was apparent that the objectives marked off significant areas of human activity but did not provide direction either for the activities or for education

In the 1930's and 1940 s experimentation was extended in the high school By then many high schools were comprehensive in character offering several different types of curriculums for known or assumed needs The sole purpose was no longer that of preparing for college It was now recognized that no matter what the future plans of the high-school student or at what point he left school (59 per cent of the population 17 years old graduated from high school in 1950) all young people moved into the responsible role of citizenship These facts coupled with the new understanding of the educative process led many to re-examine secondary-school practices

Progressive Education Association Experiments

In 1933 the Progressive Education Association (formed in 1918) through its Commission on the Relation of School and College selected 30 public and private high schools for an eight year curriculum experiment The commission secured the agreement of approximately 200 colleges to accept the graduates of these high schools on the recommendation of the principal without the usual college entrance requirements The 30 schools were thus free to experiment with curriculum reorganization, though all had the common concern of building democratic values The commission was directed by Wilfred Aikin

The first graduates of the experimental schools went to college in 1936 A staff of the commission conducted a study of these graduates while they were in college *It reported that they made slightly higher* grades than did the graduates of traditional high schools with whom they were paired for evaluation They also gained more academic and nonacademic honors than the traditional students They were more alert to what was going on in the world Ralph Tyler was in charge of the evaluative staff



NORMAN, OKLA., HIGH-SCHOOL GYMNASIUM
For big games a folding wall at the left is opened to connect the girls' and boys' gymnasiums. The band plays in its room above the folding bleachers along the right wall.

Most of these schools had introduced plans of guidance and counseling, had offered broad (or related) fields of study, and had placed an emphasis on the development of reflective thinking. The results of the work of this commission were mainly indirect. College entrance requirements were not greatly changed; but high-school teaching methods and curriculums were influenced.

Two other commissions of the Progressive Education Association were at work during these same years. One, the Commission on the Secondary School Curriculum, was directed by V. T. Thayer; the other, the Commission on Human Relationships, was directed by Alice Keliher. These commissions identified the needs, interests, and concerns of adolescents in the American culture (*see* Adolescence). They made proposals that looked forward to the reorganization of the traditional subject-matter curriculum. Thus as the *experience curriculum* began to bring a change in the elementary school, the *core curriculum*, directed toward the needs, interests, and concerns of young people, began to affect high-school practice.

The Core Curriculum in High Schools

The common experiences of individuals, rather than a common subject matter, was generally accepted as the core of the curriculum. Harold Alberty, in 'Reorganizing the High-School Curriculum', has described six types of core curriculums. These vary from the one extreme of a set of required subject-matter courses (Type 1) to the other extreme of broad teacher-student planned units of work which take their lead from the needs, problems, or interests of the class (Type 6).

Alberty believes that the core curriculum should be based upon those common needs, problems, and interests of adolescents that arise within established common or universal problem areas. He lists 19 such areas and proposes that the curriculum be organized around them. These range from orientation to the school, home, and family life to such abstract areas as personal attitudes toward war and peace. He suggests that from one third to two thirds of the school day be given to the universal problem areas. The remainder of the day would be devoted to special interest areas. Traditional subject matter would be utilized and taught only as it contributed to the solution of a problem. It would not in itself set the stage for study.

Reaction Against Specialization in Colleges

The core curriculum idea came along at a time when the problem of specialization was plaguing American education, especially higher education. The liberal arts college had gradually changed character under the demands of the developing professional colleges and expanding graduate schools. It had become preparatory to these institutions in the same way that the high school had earlier been preparatory to it. Its emphasis on the humanities had given way before interest in and need for specialization that accompanied the development of science and technology. This interest was heightened during World War II, when the colleges and universities initiated many special programs, particularly in science and technology, to support the needs of the armed forces.

Many of the colleges and universities tried by var-

A CLASS IN FAMILY RELATIONSHIPS
An alumna has brought her small daughter to this class, which is discussing child development and rearing.

ious means to combat the narrow education of specialization One of the popular *methods was to require* broad based (survey) courses in various fields such as *humanities, social science*, and natural science These were to serve as an *informed base on which specialization could* be built This was frequently called general education Its advocates urged expertness in '*the general art of the free man and the citizen*" They recommended that this end of general education *be promoted* on both the secondary and the college levels (*see* Universities and Colleges)

Democratic Values in the School

Throughout this change in schools of all levels the effort to improve the conditions of learning has been continuous On the other hand the purpose of the educational practices has not always been the same The child-centered curriculum gave way under the criticism that it lacked direction The newer progressive movements in education were accused of being without a guiding purpose

Bode and others pointed out that school programs could never get direction by centering upon the child Bode believed that direction could be had only by the acceptance of a social ideal and that in the case of America, the proper ideal was democracy His program favored the study of basic democratic values George S Counts argued that American education should openly impose democratic values This emphasis brought the problem of indoctrination to the fore Bode opposed indoctrination as inappropriate in democratic schools Educators still debate this issue

Bode and others, John Dewey especially raised the question of whether the schools should prepare young *people for life* in a planned society or in a planning society Today most educators agree that the basic American tradition is a society in which intelligence is free to deal with problems as they arise and people are free to choose among alternative solutions This shifted the emphasis to a value-centered curriculum but did not remove the social interest It merely placed education in the perspective of individuals learning to make choices among social values and developing a scheme of values by which to live The emphasis on values was emerging as the directive purpose of general education at all levels in the 1950 s

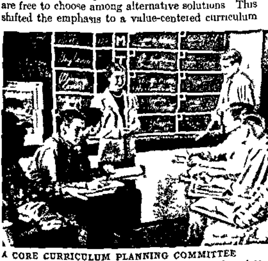
Educational practice in the public schools was further changed by the discovery that the development of democratic values was dependent on the learning situation as well as on the subject matter *Students have to participate in the ways of democracy in order to understand them* Moreover it was demonstrated that students work more *effectively in* democratic situations than in authoritarian ones

This shift in emphasis made the student a participant in planning the life of the classroom It gave the teacher a responsibility to take leadership in creating democratic relationships among students It also created a need for a school organization and administration that operated on democratic principles It is within this background that the newer movements take on meaning This is the philosophy now seen in guidance counseling the use of committees within classes the development of group planning and group evaluation and extracurricular activities It is the reason for the shift in emphasis from the learning of facts as ends in themselves to accepting facts as an aid to individual and group thinking in problem solving All these changes in educational practice were designed to make democratic learning situations available to more and more children It has resulted from the discovery that children are best educated in learning situations which use democratic practices and democratic values

Conflicts in Educational Views

Education is a human undertaking For this reason, schools continued their older ways of doing things even as they accepted the newer ideas The ways of the past linger on in education perhaps more than they do in other aspects of life This fact led to conflict in educational goals The new freedom given children in schools conflicted with a traditional notion of discipline The idea that children learned through doing conflicted with the earlier view that education was only a preparation *for later doing The conception that emphasis* should be placed upon the present interests and *problems of children conflicted* with the belief that the school should transmit the knowledge and wisdom of the past The resolution of these conflicts was of major concern to American education as it undertook to determine its proper goals in the 20th century

The reaction against the newer education has many able and vigorous representatives William Chandler Bagley believed and said forcefully that students should be taught those principles and that knowledge which



A CORE CURRICULUM PLANNING COMMITTEE
Here students and teacher schedule a week s activities for a class in the combined studies department of Evanston, Ill., Township High School.

EDUCATING THE HANDICAPPED AT HOME AND IN SCHOOL

Confined to her bed by paralysis, this student (left) attends school by telephone. She hears her teacher and class through the speaker-microphone at the left and turns a switch to recite.

This desk in a Baltimore school (right) is an example of the special equipment provided so that handicapped children can work comfortably. The boy is afflicted with cerebral palsy.

history had shown to be essential to the development of civilization. He also believed that modern schools needed a touch of "tincture of iron" to offset the emphasis on the use of interest in teaching.

Robert M. Hutchins, a leading critic of modern education, contended that education should everywhere be the same, that time and place may be ignored. He believed that a study of the best books produced by Western civilization would help modern man grasp those eternal truths that time could not change. He proposed 100 great books as the heart of a liberal education and helped initiate a program embodying this idea at St. John's College, Annapolis, Md., in 1937. Among others who were critical of modern education, either because it did not deal with universal truths or did not emphasize their conception of intellectual vigor, were Alexander Meiklejohn, Bernard Iddings Bell, Jacques Maritain, Arthur E. Bestor, Jr., and Albert Lynd.

The criticism put forward by Hutchins represented a return to the classical tradition in education. It was reminiscent of Matthew Arnold, who deplored the demands of those such as Herbert Spencer, and Thomas Huxley, who wanted the sciences studied in the schools (*see* Arnold, Matthew; Spencer; Huxley). Arnold contended that education should be centered upon "the best that had been thought and said in the world." The proposals of Hutchins and Arnold were criticized for their neglect of the present, for their limited appeal to the varied interests of students, and for their aristocratic origin.

As American education moved into the second half of the 20th century one fact was very clear. All responsible critics were certain that neither American education nor American life could progress if guided by uninformed and prejudiced minds. They did not always agree when they spoke of such educational purposes as "freeing the mind," "developing intellectual curiosity and power," "fostering the scientific spirit," "promoting individual growth," "learning to share common concerns," and the like. Yet they stood together against repression, tyranny, subservience, and authoritarianism. This was the ground on which the educational profession stood in continuing its effort to protect academic freedom, the freedom to teach so that all may be free to learn. A common purpose, *the continuous enrichment of democratic life*, was shared within education.

Special Educational Services

While the courses of study and practices in schools were undergoing these changes, new services were being introduced and extended. Special education services were developed for the physically and mentally handicapped and for both gifted and socially maladjusted children. Of the pupils aided, those with speech handicaps made up the largest group, with the backward and mentally retarded second in number (*see* Mental Deficiency). Special teachers were employed by some school systems to tutor children too handicapped to be taken to the special schools.

Health services were made available in an ever-increasing number of systems. Physicians, dentists, and nurses examined the pupils regularly, reporting disabilities to parents. The school lunch program was viewed as an aid to pupil health. The federal government, through the Department of Agriculture, contributed surplus foods bought in price support activities as well as funds to buy such foods as milk.

Guidance and counseling services were developed. They are more widespread in high schools than in elementary grades. Counselors help students with a variety of problems. They advise the young people regarding selection of school courses and their personal

and social problems They assist students in choosing a vocation giving tests to discover the student's aptitudes and providing information on suitable callings and on preparation for them (*see* Vocations) The classroom teacher is more and more considered an integral part of the guidance program

Evening Classes and Vocational Practice

The schoolhouse once empty and dark after regular classes and during summer vacation is now being used for a variety of school and community purposes Leisure-time classes in crafts and hobbies are available to students and adults alike Night schools offer vocational training and cultural courses Summer programs once limited to make-up work now offer pupils opportunities to keep interestingly busy in vacation periods Excursions sports and craft have been added to conventional courses

Vocational classes frequently call for industrial and business activity outside the schoolhouse Agriculture courses involve supervised farm practice In work experience programs students are employed a few hours a week in jobs that relate to their studies

Adult Education

The movement to offer special educational privileges to adults is widespread and many types of instruction are given in continuation schools night schools colleges and by correspondence About 3 million adults attend the programs offered by the public schools alone Courses include citizenship training for the foreign born parent education public-school education of elementary and high-school grades vocational training and university courses

The work is sponsored and organized by state departments of public instruction local school boards civic bodies fraternal societies and welfare organizations as well as by private schools colleges universities and foundations Where the program of adult education is guided by definite scholastic requirements it is usually accredited for diplomas and degrees

The School System

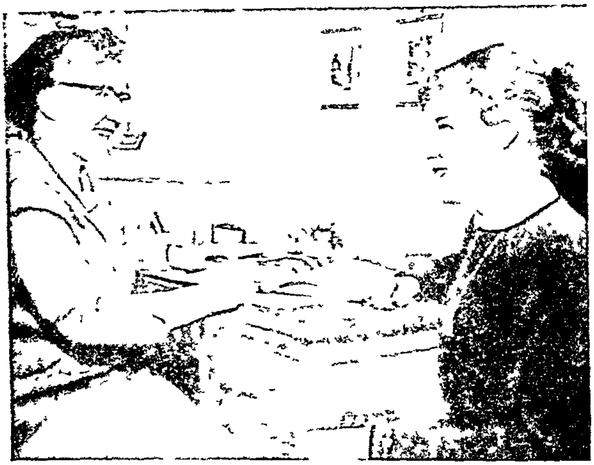
THE AMERICAN interest in public education is shown by the wide range it offers from nursery schools to adult education In some communities usually the cities the kindergarten or nursery school may mark the beginning of the system In others the first grade may be the start Public schools may include evening trade and vocational courses a junior college a four-year college or university perhaps with a graduate school All local systems extend through high school and all states provide some facilities beyond that

American education was not developed by men who were following a blueprint What is now the system of public education grew as the needs of a developing country were established and met Education has been of concern to the American people from the first colonial days yet the Constitution of the United States ratified in 1789 made no specific reference to education

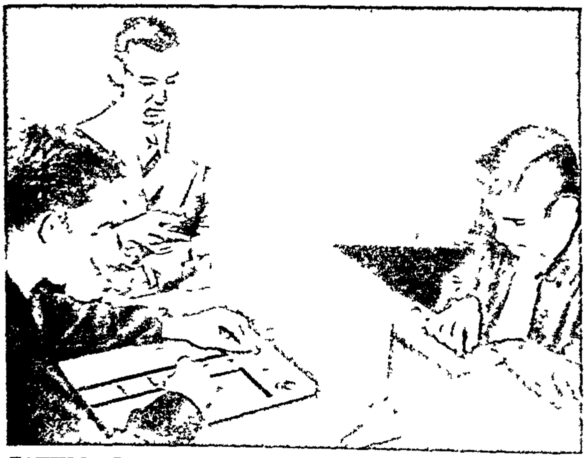
The early common or elementary schools academies and colleges provided the structure for the later development of the public education system A notable feature of American education has always been the extent of local control exercised by the citizens whose dollars support it The fact that the colonists wanted to promote religious literacy coupled with the fact that no single religion prevailed resulted both in private or church-established schools and in the local *control of public education*

As the states developed the idea of local control persisted and the idea of public education grew Horace Mann (as secretary of the Massachusetts Board of Education established in 1837) did much to advance a state program of education especially the public support of the high school Another active supporter of the public education idea was Henry Barnard He became the first United States Commissioner of Education in 1867 directing a department he had helped to establish the Federal Department of Education This division designated as the Office of Education in 1933 is now included within the Department of Health Education and Welfare Education is thus represented in the president's Cabinet (*see* Mann United States Gov-

LUNCH TIME IN A SOUTH CAROLINA SCHOOL
Children gain more than nourishment from the school lunch program They learn to choose and eat well balanced meals and to make social adjustments



BRINGING PROBLEMS TO A COUNSELOR
Counselors give guidance on school courses, vocational aims, and even on personal problems that arise outside of school.



TAKING APTITUDE TESTS IN PORTLAND, ORE.
In vocational guidance programs tests such as these are given to determine the students' aptitudes for various occupations.

ernment, section "X. Department of Health, Education, and Welfare").

From 8-4 to 6-3-3 Plan

By 1950 the early plan of organizing students by grades into an eight-grade elementary school and a four-year secondary school (the 8-4 plan) had been generally replaced by a 6-6 or a 6-3-3 plan. The middle three years, grades seven, eight, and nine, became known as the junior high school. This division was made to aid the transition of the emerging adolescent from the general elementary program to the more diversified and specialized high-school programs.

The junior high school, not developed in the rural areas at first, became more available to country children as the movement to consolidate rural schools was advanced. By the mid-1900's the school bus, usually yellow, was a familiar sight on the highways of the nation. Consolidated schools were at last replacing the little red schoolhouse of earlier years.

A further development of the public education system took place with the introduction of the junior college during the first half of the 20th century. This institution developed rapidly, there being nearly 500 of them by 1950. It fitted into the scheme of free schooling by making it possible for many students to extend their education without going away from home to the colleges and universities. In its initial conception the junior college offered technical and vocational training as *terminal education*. The American student soon incorporated it into *the ladder system* of his country. Many junior colleges responded by offering "general education" and the standard courses of the first two college years. The student thus received full credit if he transferred to a four-year college or university.

Growth of Higher Education

Higher education at the state level was speeded up when the Morrill Act was passed in 1862 by the United States Congress. This act gave grants of public land to encourage the states to establish colleges that would teach agriculture and mechanics and the liberal arts. Some states created separate agricultural and mechanical colleges; others added these courses to an already existing state university.

These institutions flourished. Along with all other institutions of higher learning their enrollment increased sharply when the effects of the Servicemen's Readjustment Act (the "G. I Bill of Rights") of 1944 were felt. This act gave federal financial aid to former servicemen to continue their education toward a self-chosen vocational end. Comparable assistance was given American servicemen who took part in the action in Korea. These aids, combined with the increased birth rate during and following World War II and the growing tendency of American youth to seek more education, led to the prediction that enrollments in higher education would be about 4 million by 1965. Approximately $1\frac{1}{2}$ million had been enrolled prior to World War II.

Paying for American Education

The faith of the American citizen in education has been shown with each extension of the public-school system. He pays the bill and, for the most part, he pays it locally, out of taxes that he votes himself. The local community is the chief source of income for the schools. (In some Southern states the county is the educational unit.) A tax on property is the chief instrument for procuring this income. Other forms of taxation are today being sought because the property tax is less adequate than it was. Many small towns and large low-cost housing areas without industry are finding it very difficult to build and support local schools on available tax income.

State and federal forms of support for public edu-

cat on have ar sen to nibble away at the historic concept of education as the busine°s of the local community Programs of state aid have been de veloped to provide a minimal educational opportunity for all the children of the state without regard to the wealth of the school district In this sense the con cept of local support has been extended to the bound ar es of the states On the average states now provide about 40 per cent of the school cost

The Question of Federal Aid

A problem of inequality in wealth also arises between states In some states the annual expenditure for each public-school student is about $300 in others it is well under $?00 Yet the young people of all states are future c tizens of the nat on as a whole Their freedom of movement as American citi zens may lead them to establ sh residence n any of the states or territories Tl is has led many ed icators and cit zens to advocate a policy of federal aid to equalize educational opportunit es Several fed eral aid bills have been before the Congress In 1955 the critical shortage of classrooms led the govern ment to consider ways in which federal part cipation in build ng programs could help local communities extend the r facilit es The fear of federal control of education that might come with federal aid has made the American citizen hes tate to accept federal help

This attitude has not been weakened by h s acceptance of aid at the state level or by his acceptance of some measure of federal support for specific pur poses The Morrill Act and the G I Bill of Rights are cases in po nt A federal policy of a ding edu cation was early adopted An ordinance adopted in 1785 bearing on the disposal of western lands reserved lot No 16 of every township for the ma n tenance of public schools with n the sa d township (*see* Northwest Terr tory) This was an outrigl t gift to the people of the state to encourage them in the development of education Later as new states were admitted to the Un on schools were given two lots—and some of the last to be admitted four—in each to nship

Other support has been more spec fic In 1917 the Smith Hughes Act made provision for the inclus on of instruction in agriculture home economics and trade and industrial subjects in the high school It prov ded for prep aring teachers of these subjects The federal grants of money under this act l ad to be matched dol lar for dollar by the community the state or these together In 1936 the h gh schools were encouraged to provide instruction in the distribut ve or selling occupat ons by the passage of the George-Deen Act

Common Features of State Systems

Each state and each territory has its own school system Yet the visitor to a public school elementary or secondary in Honolulu T H or Hollywood Fla would find more similarities than differences Each state system has developed with n a common tradi tion and each has been strengthened by the experi ences of the others New York for instance estab lished The Un vers ty of the State of New York in 1784 w th a board of regents The name is m slead ing It was a state board of education with certain jurisd ction and powers over the colleges and academ es Massachusetts established a state board of educa t on in 1837 and other states followed Forty three states now have such a board four have vocational boards and one has both a state board and a vocation al board Some boards are granted more power than others The tendency is to have one board in control of all elementary secondary and vocat onal educat on

New York prov ded for a State Superinten lent

FAMILIES USE THE SCHOOL S CANNERY
The modern trend is toward greater community use of the school Here farm folk are canning corn at a rural-school service cen ter in South Carolina Supervised by home economics and agri culture teachers centers provide both instruction and service

of Common Schools in 1812. All states now have an officer, usually called Superintendent of Public Instruction, to direct the department of education.

The state agencies set up standards for local school bodies, such as educational standards for teacher certification, building construction standards, and safety standards for school transportation. All states have compulsory attendance laws. In most states attendance is required from 7 to 16 years of age, though the range is from 6 to 18 in some.

Another common feature in school organization is the school district. (There are about 63,000 of these in the nation.) The school district is under the control of a local board of education or a school committee. Their job is not to run the schools but to see that they are properly run. Their authority comes from the state legislature. In the interest of efficiency and improved school programs, the present tendency is to reduce the number of school districts by consolidating them into larger units.

The mobility of the American people made some standardization of school organization necessary. Moreover, the American educator, through his numerous professional associations and publications, has shared his concern about improving his practices. Ideas are not kept within state or local boundaries. Newspapers, magazines, radio, and television have shared the ideas with the lay citizen.

A further factor in advancing the common practices on which the system rests has been the work of the United States Office of Education. It has been the responsibility of this office to collect information about the state of education and to make it generally available. It disseminates information through reports of special studies, through a monthly magazine, *School Life*, through a biennial survey of education, and in conferences for both school people and laymen.

A ONE-ROOM RURAL SCHOOL IN OHIO
Country schools decreased 60 per cent between 1930 and 1950. Pupils are now taken by bus to consolidated schools.

Private Schools in America

Side by side with the public educational system, private and parochial schools and colleges flourish Some of these schools carry into the present the traditions that brought them into being. Many people support private schools because they believe they provide a better education than public institutions Others support them to obtain what they believe to be a better social opportunity for their children The parochial, or church, schools are supported because the public schools do not provide religious instruction. The private school was gaining enrollment in the 1950's, enrolling about one in every eight elementary and secondary students. In 1940 the proportion had been about one in every eleven.

Legal Basis of Private Schools

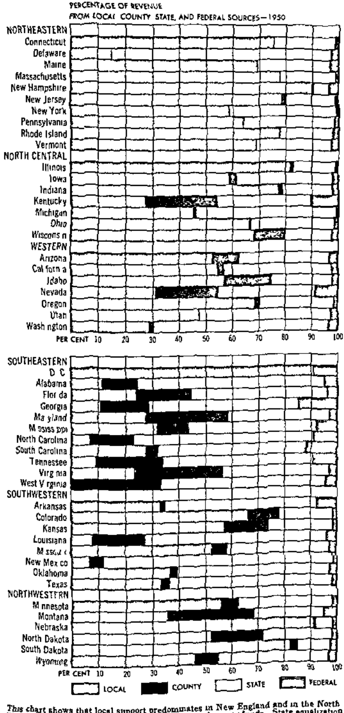
Not all citizens are happy about either this tradition or the trend. Many persons believe that democracy gains in strength through the association of all the children in the public schools, at least until the college years. The United States Supreme Court in 1925, however, ruled unconstitutional a law enacted in Oregon in 1922 which required all children of that state between the ages of 8 and 16 to attend a public school. The opinion held that the state had the right to require school attendance but the parents had the right to send their children to the school of their choice.

Another issue of considerable concern to the citizen had to do with the matter of support for the schools that are outside of the "public system." The principle of universal taxation among the citizens for the support of public education is well established; so too is the separation of church and state. The first amendment to the Constitution states: "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof..." Yet with the growth of the denominational schools, especially as this is reflected in a developing Catholic system of education, the issue of support has been revived. Somewhat more than $4\frac{1}{2}$ million children attend denominational elementary and secondary schools. Many parents are restive under what they regard as double taxation. The Supreme Court has ruled against direct aid to denominational schools It has, however, permitted indirect aid, such as using public funds to transport students and to supply free secular textbooks. Indirect aid has been sanctioned because it is aid given the student, not the school

The Teaching Profession

The need for preparing teachers came with the creation of a public-school system. All states now provide for such education in separate teachers colleges

Levels of Government Support of Public Schools



This chart shows that local support predominates in New England and in the North. The Southern states rely more heavily on state and county funds. State equalization funds are used to attain minimum standards of instruction and housing.

or in schools or colleges of education that are a part of the state university. The first American normal school was established in Massachusetts in 1839. A few are still in operation but are undergoing the changes that will transform them into *four year* degree granting teachers colleges. Some teachers colleges offer the master's degree as do the colleges of education. These also offer programs that lead to the doctor of philosophy degree or to the professional degree doctor of education. Many private colleges and universities also prepare teachers.

The states through their boards of education or superintendents of public instruction issue certificates permitting applicants to teach in the public schools. Scholastic requirements for such certification have risen steadily. Most states require four years of college preparation for high school teaching. Requirements for elementary teachers are often somewhat lower. The average preparation today for elementary and high school teachers is between three and four years of college work. One teacher in four attends summer school or enrolls in extension classes to improve his or her education.

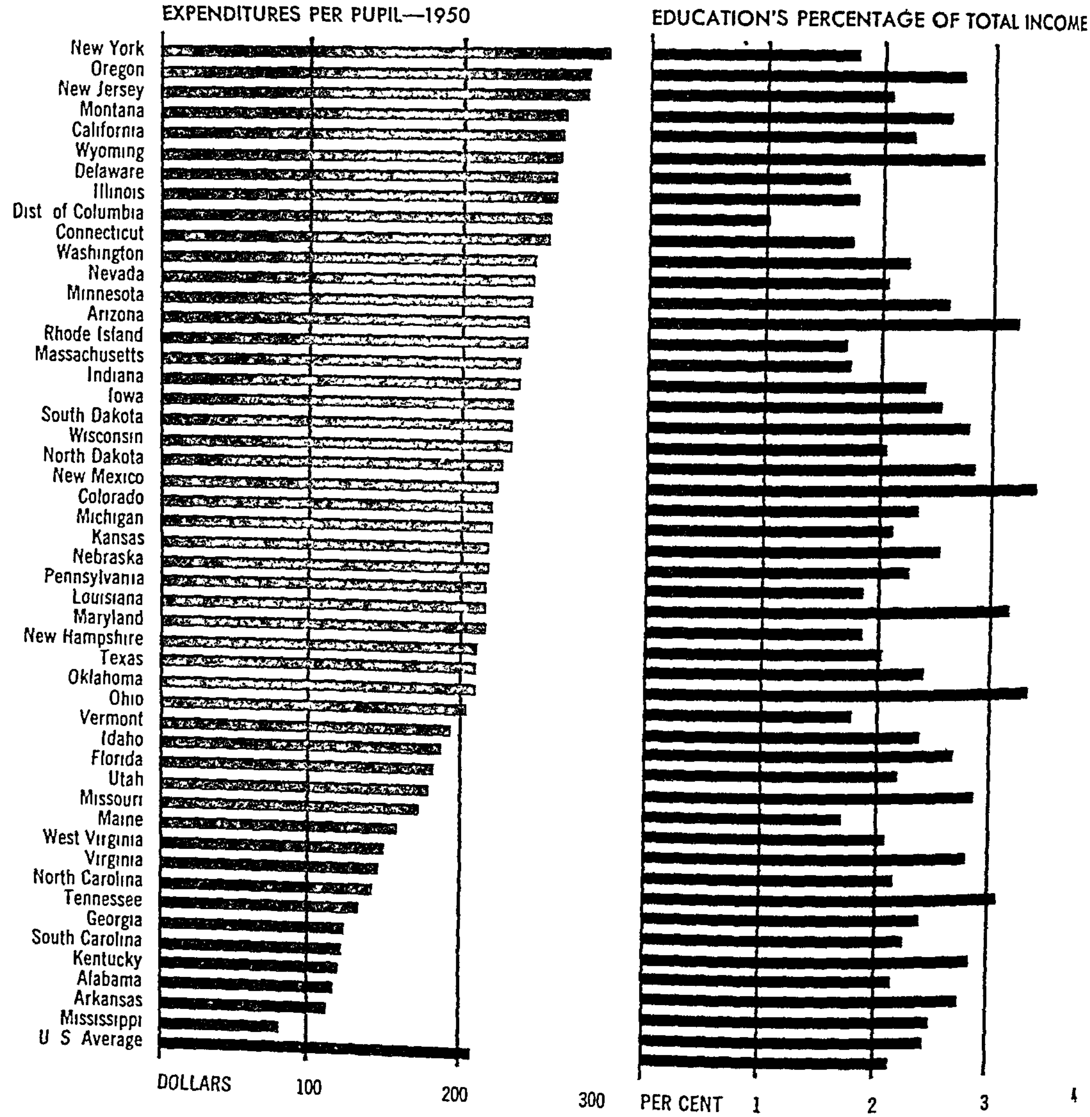
In the 1950's there were more than one million teachers in the public elementary and secondary schools. This included nearly 70,000 individuals who had been granted emergency, or substandard certificates.

Reasons for Teacher Shortage

Thousands of additional teachers are and will be needed at all levels. The shortage is attributable to many factors. Many teachers and potential teachers were lost by the schools either to the services directly or to government and industry during World War II. For personal reasons, including economics, many of these did not return. The American public has been insistent upon the continuous extension of education. It has not been insistent upon a salary scale that would keep other callings from luring the teacher away from the profession. This situation is only gradually being corrected.

Many educators who freely admit that the salary situation should be

Annual School Expenditures in High- and Low-Income States



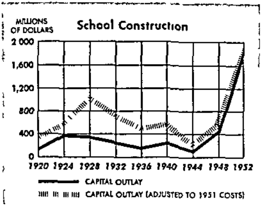
The first column shows expenditures per pupil in average daily attendance in the public schools for 1950—not including capital outlay or interest on debt. The national average of $209 is 138 per cent higher than the 1940 average. The second column shows the relationship between the income of the people and the expenditures on public schools in each state.

improved, feel that the emphasis needs to be placed at other points if young people are to be attracted to the profession. Teaching is a basic need of a democracy and teachers are in the front line of its defenders. A democracy could not survive with an ignorant citizenry. Dedication to a cause may be felt wherever teachers come together. The satisfaction gained from contributing to this cause may be sensed whenever teachers exchange ideas about the young people they influence. Teaching is hard work, extending beyond the class hours of the day or the week of the school year. It is also rewarding to the spirit of the teacher. These rewards could be enhanced in each community.

Time has changed the status of the teacher. He now lives under fewer restrictions and enjoys more of the privileges of other citizens than formerly. The conditions of his work have been improved with the construction of new buildings, although an overcrowded classroom in a new building offers little improvement over an overcrowded one in an old building.

Citizens and Professional Organizations

Significantly, in the 1940's citizens in large numbers became aware of their need to understand better the educational problems of their communities. In addition to their participation in local parent-



This graph reveals the sharp rise in school construction since World War II Due to growing enrollments a huge shortage in classrooms remains despite the costly building program

teacher associations, they organized school-community councils or committees (*see* Parent-Teacher Associations) This latter movement was given impetus in 1949 by the formation of the National Citizens Commission for the Public Schools Hundreds of committees have been formed by interested citizens at state and local levels, to seek ways in which to improve the schools This interest will do much to advance the status of the profession and to bring teachers and citizens to share in solving democracy's crucial problem the education of its future citizens

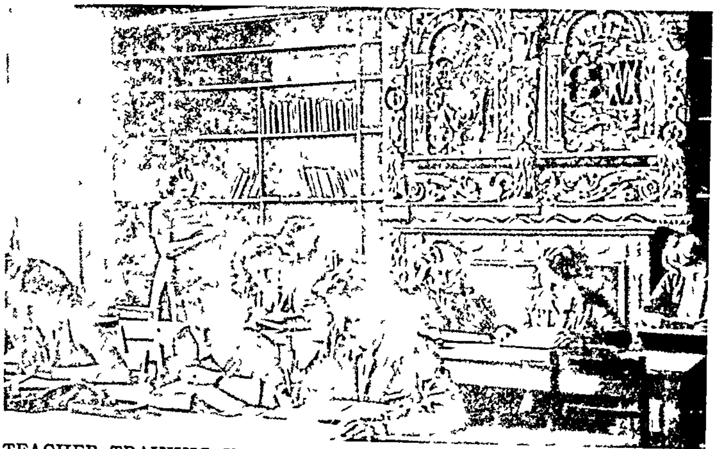
The educational profession has worked and continues to do so at self improvement The institutions that prepare the teachers have undertaken, through research and self-study to improve the differing teacher education curriculums School systems have initiated programs of in-service or on-the-job training and have rewarded teachers for summer study and travel by salary increases Professional organizations by holding annual conferences and publishing magazines and yearbooks have stimulated interest within the profession and have kept it informed on the basic issues it faces

The National Education Association the largest organization of teachers in America co-operates with state education associations to advance the effectiveness of public education Its departments and commissions such as the Association for Supervision and Curriculum Development the American Association of School Administrators and the Educational Policies Commission address themselves to specific aspects of the problem One of its commissions created in 1941 the National Commission for the Defense of Democracy Through Education has the difficult task of helping the profession and the public to differentiate between the responsible critic of public education and the irresponsible one It presents its analyses in the *Defense Bulletin* published monthly.

Education in European Countries

ONE OF the significant educational events in America following World War II was the marked increase in the number of students especially graduate students who came to it from other countries Many educational leaders from the occupied nations Germany and Japan, also came to observe and study all aspects of American education These educators were brought to America first by the military government operating in these two countries and later by the Department of State In turn many American educators were sent to occupied countries to help plan their educational reconstruction

CITIZENS STUDY SCHOOL PROBLEMS IN NEW YORK
Here a parent teacher workshop discusses the aims and methods of a new curriculum. Many citizen groups are working to understand and improve the schools The National Citizens Commission for the Public Schools co-ordinates their activities



TEACHER TRAINING IN AN ENGLISH CASTLE
Here British student-teachers work in a training school set up in Elvaston Castle, near Derby, England. Increasing postwar attendance emphasized a world-wide teacher shortage.

Further interrelationships were brought about by the creation of the Fulbright fellowships, which made it possible for American citizens to teach and study in other countries and for foreign students to teach and study in the United States. These fellowships were established by the 79th Congress (Public Law 584) and named after Sen. J. William Fulbright, who introduced the legislation. The Department of State and private agencies such as the Ford Foundation also aided the interchange of teachers and students. There was the likelihood that American educational thought and practice would influence the future development of education around the world.

Soviet Educational Theory and Practice

One portion of the world, Russia and its satellite countries, was untouched by this exchange of ideas and of people. In Russia significant educational reform had been under way since the Communists replaced the czarist regime in 1917. Prior to this, educational opportunities had been stringently limited. About 70 per cent of the people were illiterate. The Communists initiated programs, on a vast scale, to disseminate the Communist doctrine throughout the U.S.S.R. and to develop schools that were free, compulsory, universal, and classless. The programs include a common school course—elementary, from age 8 to 12; secondary, up to age 18. This is followed by vocational and scientific schools for all careers (including teaching) and by colleges. It is preceded by preschools for children from age three to seven.

In the early years there was much enthusiasm for progressive methods, but the American influence did not last long. After 1931 progressive practices were discarded. Authoritarian discipline came to the fore, but an emphasis on developing the ability of the student to act in terms of the ideas he gained was maintained. There was an attempt to keep school life and community life and practice in close relationship. From 1943 to 1954 most secondary schools were separately developed for boys and girls

The "iron curtain" prevents the world from securing a clear view of how education now progresses in Russia. It is evident that, however widely developed, it serves the motherland in whatever ways the leaders demand. This service, in scientific and technological developments, appears to be considerable.

English and French Systems

The educational systems of England and France, though they differ in many details, share a conception of student selectivity that places them in contrast with the American system. These countries, though no less interested in democracy, place their faith in a selective process for the preparation of leaders.

The Education Act of 1944 in England opened the way for the extension of free public education. It called for a huge building program to relieve overcrowding and to provide additional secondary schools. Attendance was made compulsory through age 15 and later through age 16. Children from 5 through 11 attend primary schools, with nursery schools provided for children from 2 to 5. Secondary schools enroll pupils from 12 through 18. Various adult education schemes are provided. In place of the former national board of education, a Ministry of Education was established with greater power.

England has a "two-track" scheme of education. Students take an examination at the age of 11 for the opportunity to move from the primary school to the grammar schools, which prepare for college. If they do not qualify, and the percentage who do is small, they may enter the secondary modern school or the secondary technical school.

England's famous "public schools," such as Rugby, Eton, and Harrow, are, in American terms, private and usually charge fees. Private schools must provide "free places" to receive aid from the government.

In France, after World War II, there was a tendency to break down the rigid educational scheme that permits only a selected few to get into the secondary schools and hence into college. Under this system, pupils who fail to pass the secondary examination at 11 years of age may stay with the primary school until the school-leaving age of 14 or attend "complementary schools" for four years. France, which provides much less than does England for the exercise of educational initiative in local communities, plans a relaxation of central controls.

The Scandinavian countries have a tradition of free, compulsory education. In line with their extensive social programs, they have increased the number of years of compulsory schooling in recent decades and have extended adult and supplementary courses. Most educational institutions, including the universities, are free. (For information on systems and standards

of foreign nations *see* in FACT INDEX names of individual countries subentry education.)

Prewar and Postwar Education in Germany

Education in Germany was devastated during World War II. School buildings and libraries were destroyed and in cities such as Bremen and Berlin all schools were closed after 1943. In addition the educational system was used by Hitler to promote Nazi aims. After the war the country was occupied and divided among the victorious Allies. The schools in East Germany were integrated by Russia into the Communist pattern. They are centrally controlled.

Prewar German education led the pupils into differing pathways, with one reserved for the select few. After the first four years of a shared elementary school (the *Volksschule*) to which all started at six years of age, 15 to 20 per cent of the pupils were destined for the university. They attended a secondary school where tuition was charged. Almost all the rest of the students remained in the elementary schools for four additional years. A small percentage entered the *Mittelschule* where they remained through the tenth grade. Here emphasis was on technical and business training. Children who left school to work at 14 or 15 years of age were required to attend vocational schools several hours a week.

Much of the same school organization was followed after postwar reconstruction, when the various *Länder* or states took steps to improve their schools. Some of them increased the number of years of schooling offered and others provided more opportunities for talented children to enter secondary schools. Many eliminated tuition in secondary schools.

German universities prior to World War I at least were distinguished centers of research and scholarship. They had exerted marked influence upon American higher education, especially the graduate schools.

American Influence Abroad

The United States made every effort in its area of responsibility in West Germany to reactivate the educational machinery. It tried to operate the schools so that they would function in terms of democratic purposes. American help was at hand but German professional personnel was given responsibility. One important task was the removal of former Nazis as teachers. Another was the production of textbooks to replace those which glorified the Hitler doctrines.

In all parts of the world educational practice is undergoing change. This is especially true among the people who are striving to gain the freedoms in their lives which they have seen to characterize democratic countries. American influence may be felt everywhere. It will certainly be felt in Germany, Japan, and Korea. Much aid toward rehabilitation has been given in each country. (*See also* Japan, section Postwar Education and Government.)

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EDWARD, *Kings of* ENGLAND

THREE Anglo-Saxon kings bore the name of Edward before the Norman Conquest (1066). Eight king Edwards have reigned since that time. As the numbering of English rulers of the same name goes back only to the Conquest, the three earlier Edwards have only distinguishing nicknames.

EDWARD THE ELDER (ruled 899–924) was the son of Alfred the Great (*see* Alfred). He conquered a large part of central England which at Alfred's death still remained in the hands of the Danes.

EDWARD THE MARTYR (ruled 975–978) obtained his nickname because of a miracle supposed to have been performed at his tomb in Shaftesbury. He had been buried there after being murdered by the retainers of his half-brother, Ethelred the Unready, who succeeded to the throne.

EDWARD THE CONFESSOR (ruled 1042–1066) was the elder son of Ethelred the Unready. His election to the throne after the death of the Danish king Harthacanute marked the end of Danish rule in England. Edward was noted alike for his weakness as a ruler and his piety as a man. His great legacy to England was Westminster Abbey.

EDWARD I (born 1239, ruled 1272–1307) was one of England's greatest kings. He was a handsome man, with fair hair and ruddy cheeks, and so tall that he was nicknamed "Longshanks." He delighted in tournaments and hunting, but he was also practical and hard working. For seven years before he came to the throne he was the real ruler for his weak father, Henry III (*see* Henry III; Montfort). He was in the Holy Land on a Crusade when his father died, but there was no question of his succession to the throne.

Edward has been called the "English Justinian," because, like that Roman emperor, he organized the laws. His laws were not restatements of existing customs but "statutes" in the modern sense. Many of them, particularly the land laws, had a long-lasting influence. A statute of 1285 limited church courts to strictly church matters—a change that Edward's great-grandfather, Henry II, had been unable to make because of the murder of Thomas Becket (*see* Henry II). Edward also ceased paying a feudal tribute to the pope.

Parliament grew in strength during Edward's reign because he continued the policy of Simon de Montfort in summoning to it representatives of the towns and lesser knights. His parliament of 1295 is known as the Model Parliament (*see* Parliament). In 1297 he reaffirmed the Magna Carta in the famous "Confirmation of the Charters." A step of a different kind taken by Edward was the expulsion of Jews from England in 1290.

Edward the Confessor—so ca ed because of h s p ety d ed a few days after Westmins e Abbey wh ch he built was conse ated He was reared in F ance and at heart was mo e l ke a F ench monk than an English king

Edward VII who had been a worldly prince of Wa es earned the t le of Edward the Peacemaker because of his prolonged efforts to main ain peace in Europe Four years after his reign ended the first World War began

Soon after coming to the throne Edward conquered Wales and gave to his infant son Edward the title Prince of Wales (*see* Wales) Until 1289 the care of h s French possessions principally Aquitaine in Southern France absorbed much of his attention For the rest of his life his main concern was Scotland He conquered the country in 1296 but in 1297 all Scotland rose in revolt against him under the popular leader Will am Wallace Edward defeated Wallace at Falkirk the next year but the Scots still res sted Near the end of Edward s reign Scotland found a new leader in Robert Bruce In 1307 King Edward then 70 years old led an army toward Scotland but died before he reached the border

EDWARD II (born 1284 ruled 1307 1327) the son of Edwar l I was the first Engl sh prince of Wales (*see* Wales) He was tall and handsome like his father but he was a co vard in battle and in sp te of h s father s careful training he had no aptitude for government His reign was one of disorder and disaster He cont nued the war with Scotland that his father had begun The Scottish leader Bruce defeated the English forces in the famous battle of Bannockburn (1314) and compelled Edward to recog nize the independence of Scotland

In 1326 the king s enemies planned a widespread revolt They easily captured the k ng and in Jan uary 1327 Parliament declared him deposed and set in his place h s young son Edward III Eight months later the deposed king was brutally murdered

EDWARD III (born 1312 ruled 1327 13 7) became k ng at the age of 15 when h s father Ed vard II was overthrown He proved himself a chivalrous knight rather than a great ruler He loved warfare l ke so many of his line and tried to give it the glamour of the good ol l days by setting up a Round Table at Windsor Castle in imitation of King Arthur He also organized the most famous of the English chivalric orders of knighthood the Order of the Garter He gained temporary glory but no lasting profit through prolonged fighting in Scotland and in France where he began the Hundred Years War (*see* Hundred Years War English History)

During Edward s reign a terrible plague called the Black Death wiped out from one third to one half of the country s populat on and caused great social and economic changes (*see* Black Death)

EDWARD IV (born 1442 ruled 1461 1483) was the first of the York st kings He grew up in the midst of the struggle between two great families York and Lancaster that is known as the Wars of the Roses (The Yorkists took a white rose as their badge and the Lancastr ans a red one *See* Roses Wars of the) Edward became the leader of the Yorkist party through the death of h s father Richard duke of York at the battle of Wakefield (1460) He secured the throne the next year largely through the support of his powerful cous n the earl of Warwick later called the Kingmaker

Edward soon offended Warwick by marrying against his wishes Elizabeth Woodville and placing his wife s relatives in positions of influence at court Warwick finally went over to the Lancastrians and forced Edward to leave England and take refuge in

Flanders (1470). Edward, however, proved more than a match for his enemies. He returned to England in 1471, defeated and killed Warwick in battle at Barnet, in Herts, and re-established himself on the throne. Immediately he caused the insane Henry VI to be killed; and some years later he brought about the death of his own brother, the duke of Clarence.

A popular and able ruler, Edward encouraged trade and helped restore the country to a settled condition. By relying on the growing merchant class rather than on the feudal nobility, he won back for the kingship much of the power that had been lost to Parliament by the Lancastrian kings. Soon after Edward's death, his young sons were murdered (*see* Edward V).

EDWARD V (born 1470, ruled 1483), the elder son of Edward IV, was nominally king from April to June 1483. His uncle Richard, duke of Gloucester, got himself appointed Protector and soon afterwards the king, then only 13, and his younger brother Richard, duke of York, were shut up in the Tower of London. Neither was ever seen alive again. Probably they were murdered by order of their uncle, who had himself crowned king as Richard III. In 1674 some bones of two children of about the age of the two brothers were found in a wooden chest when a building of the Tower was being altered. Careful examinations indicated that the bones were the remains of the two unfortunate princes. (*See also* Richard III.)

EDWARD VI (born 1537, ruled 1547–1553) belonged to the House of Tudor, which came to the throne on the fall of Richard III in 1485. The son of King Henry VIII by his third queen, Jane Seymour, he became king at the age of ten. Great things were expected of the young ruler, but he was never strong and died of tuberculosis at the age of 16. During his short reign the government was controlled first by his mother's brother, the duke of Somerset, and then by the duke of Northumberland. Edward VI was succeeded by his half-sister, Mary.

EDWARD VII (born 1841, ruled 1901–1910) was 60 years old when he succeeded his mother, Queen Victoria, to the throne. He had married Princess Alexandra of Denmark in 1863. Before his accession, he was continually before the British public as the most active member of the royal family, owing to Queen Victoria's retirement during her long widowhood. He was a man of unusual social gifts and worldly experience, and as king his course was marked by tact and judgment. In the field of diplomacy he used his intimate knowledge of Continental courts to strengthen Britain's position in Europe. He played an influential part in bringing Great Britain, France, and Russia together in 1907 into the Triple Entente—the alliance which, at the beginning of the first World War, aligned these nations against Germany and Austria.

EDWARD VIII (born 1894, ruled 1936) was nearly 42 years old when he became king on the death of his father, George V, Jan. 20, 1936. Toward the end of the same year he expressed the desire to marry an American woman, Mrs. Wallis Warfield Simpson. Mrs. Simpson had already been married twice, and her second divorce had not yet been made absolute. The British ministers and the governments of the Commonwealth did not consider that Edward's choice was in keeping with the dignity and traditions

THE DUKE AND DUCHESS OF WINDSOR

Edward VIII, king of Great Britain for 326 days, gave up the throne and became Duke of Windsor. In his abdication speech he said he found it impossible to discharge his duties as king "without the help and support of the woman I love."

of the Crown Edward, however was determined to proceed with the marriage, and on Dec 11, 1936, he abdicated He was succeeded on the throne by his younger brother George VI The first act of the new king was to name his brother duke of Windsor The duke married Mrs Simpson in France on June 3 1937

EEL The common fresh-water eel is a long slender fish with a gracefully waving fin that runs in a continuous line the length of the back and around and under the tail It has a small conical head a pair of fins just behind the head and a wide mouth with strong teeth The scales are so tiny and so deeply set in the flesh that the fish appears to be scaleless It has a slick, velvety appearance is olive brown on the back, fading to greenish yellow on the sides and gray or white below

Eels are common in the fresh waters of the world They are abundant in the rivers that flow to the Atlantic coast of North America and throughout the Mississippi River valley, but there are no fresh water eels on the Pacific coast

The eel's life is one of the most extraordinary dramas of mystery and adventure that science has ever solved At certain seasons swarms of young eels appeared in the rivers, and the grown eels swam down stream to disappear into the sea What happened before and after was unknown The Greek philosopher Aristotle guessed that young eels sprouted from the mud itself Two thousand years later Izaak Walton reported in 'The Compleat Angler' an even wilder theory, that horsehairs in water turned into eels

The first clue to the mystery was the discovery of the *Leptocephali* about 150 years ago, in the waters of the Atlantic and the Mediterranean These are creatures with tiny heads and ribbonlike bodies transparent as glass They were long supposed to be a kind of fish new to science During the latter half of the 19th century several experimenters found that *Leptocephali* kept in aquariums, turned into young eels

Life Story of the Eel

With this fact to help him a young Danish scientist, Johannes Schmidt began in 1905 to track down the secrets of the eel Before his death in 1933 Professor Schmidt had made six cruises, covering more than 40 000 miles and had dredged up from the ocean depths the answer to the puzzle William Beebe's deep-water explorations corroborated Schmidt s findings

Let us start the story with a full-grown eel that has been living in the headwaters of a stream in the Eastern states It is a female for there are no males in these waters As fall approaches she puts on an extra layer of fat and stops eating Her olive skin takes on a silvery color Her snout gets sharper and her eyes grow large and bulging She starts toward the sea and finds herself in company with other females that have become "silver eels" like herself Near the mouth of the river where the water begins to be salty, the smaller male eels appear and join the migration Out into the Atlantic they swim, gradually going deeper and deeper At last they reach the warm waters of the Sargasso Sea in a tract south of Bermuda and about 900 miles east of the American coast There in the blackness, 3 000 feet down the females lay their millions of eggs and the males fertilize them Then the grown eels die

Within a few days the glasslike baby eels, or larvae, a quarter of an inch long hatch from the eggs Each larva carries a tiny drop of oil which floats it upward toward food and sunshine At first it simply drifts, feeding with needle-sharp teeth on the microscopic life at the surface Then it begins to grow and to swim slowly toward the land A year later, when it nears the American coast the eel larva is about three inches long This is what used to be called a *Leptocephalus* Soon it begins to shrink The high, thin body shortens turns pink and becomes round—much the shape and size of a common wooden match The larva has turned into an *elver* or young eel

Fresh Water Life Begins

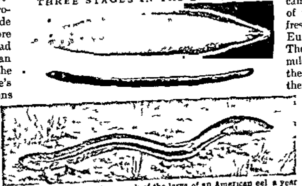
Thousands of elvers swim into the rivers on the Atlantic coast early every spring The males remain in the brackish tidewater but the females swim far up and may make their homes in the smallest creeks

The stay of the eels in inland and coastal waters ranges from 4 to 6 years for the males and from 7 to 8 years for the females They eat anything live or dead that they can swallow In winter they hibernate in the mud At maturity the females are usually from 2 to 3 feet long the males about two thirds as large Occasionally a female fails to develop the breeding instinct and may live on in some fresh-water pool for 40 years or more growing to a great size

Along with the American eels in the depths of the Sargasso Sea, the fresh-water eels of western Europe come to breed They have to travel 4,000 miles to get there To give the larvae time to make their way back to Europe their change into elvers takes three years instead of one

Professor Schmidt showed that similar central breeding places exist for the eels of Africa, of Asia and of Australia No eels of this

THREE STAGES IN THE EEL S LIFE



At the top is a life-size photograph of the larva of an American eel a year after it hatched from the egg In the second picture the larva has shrunk in size and turned into an elver At the bottom, a grown eel is shown, about one sixth its actual size

type are found in South America or on the west coast of North America, probably because there are no ocean currents favorable to the return of eel larvae.

The conger eels that frequent the coasts of Europe and eastern North America are strictly salt-water fish. They may grow from 4 to 6 feet long and they are much thicker than the common fresh-water eels. Some congers breed in the Sargasso Sea, some near the Azores, and some in the Mediterranean.

In warm seas live the eels called *morays*, many of which are brilliantly colored. The "muraena" so highly prized by the Romans belongs to this group.

Fresh-water eels, conger eels, and many of the morays are good to eat. The meat is nourishing and delicate when properly cooked, though some find the flesh oily and the fine bones difficult to remove.

Eels belong to the order *Apodes*, or "footless" fishes. Among their distinguishing features are tiny scales so deeply buried in the skin that eels are commonly thought to be scaleless. The scientific name of the American fresh-water eel is *Anguilla bostoniensis;* of European species, *Anguilla vulgaris;* of American conger, *Conger oceanicus;* of European conger, *Conger vulgaris;* of the Roman moray, *Murena helena.* The "electric eel" of South America does not belong to this group, but is related to the carps and catfish (*see* Torpedo Fish).

EGG. All animals and plants, except the most primitive types, begin life in the egg. The egg is a single female *germ cell* which is able to develop into an independent new life when it has been fertilized by a male cell (*see* Biology; Heredity). The egg cells of plants when fertilized turn into seeds (*see* Flowers; Seeds).

In mammals, life begins with the female egg cell, called an *ovum*. When it is fertilized by a male cell it almost immediately begins to divide, a process called *fission*. The development and growth of the young mammal take place inside the mother's body between the time of fertilization and birth. During this stage it is called an *embryo*. The only mammals that depart from this rule are the duckbill and the spiny anteater (*see* Duckbill). All other animals that come from eggs undergo their development *inside the egg*.

A true egg, as distinguished from an egg cell, consists of the germ cell and materials for the nourishment of the embryo, enclosed in a protective covering. The covering may be a rigid shell of calcium, like the eggs of birds, or a tough, elastic membrane, like the eggs of most reptiles.

All birds lay their eggs before they are ready to hatch. The females of certain snakes, lizards, fishes, and insects keep the eggs inside their bodies until the moment of hatching, so that their young seem to be born alive like those of mammals. Animals of this type are called "viviparous" (live-bearing) to distinguish them from the "oviparous" (egg-laying) animals.

Differences in Egg-Laying Habits

The egg-laying habits of animals seem related to the dangers to which their eggs are exposed. Thus the auks, which nest in inaccessible places, lay only one egg each season. Certain fishes, such as the cod, the sturgeon, and the turbot, whose eggs are food for hundreds of enemies, lay millions at a time.

Many birds build very elaborate nests to shelter their eggs (*see* Birds). Insects protect their eggs in complex ways too. Bees and wasps lay them in specially constructed wax cells; ichneumon flies plant them in the bodies of other insects; the gall flies embed them in plant tissues; buffalo gnats glue theirs to submerged rocks (*see* Insects).

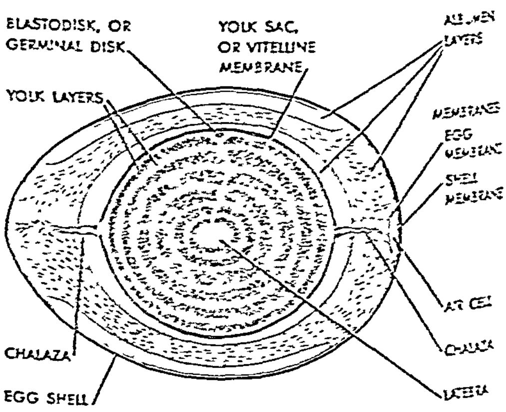
Reptiles, as a rule, leave their eggs to be hatched by the heat of the sun, but nearly all birds warm their eggs with their own bodies to develop and hatch them. Australia, however, produces a group of birds which hatch their eggs like reptiles. They are called the *Megapodes.* The brush turkey of eastern Australia and the mallee bird of western Australia, for instance, simply scratch up mounds of earth and leaves, lay their eggs in the mound, and let the heat generated by the sun and by the decaying vegetation do the work.

The Hen's Egg

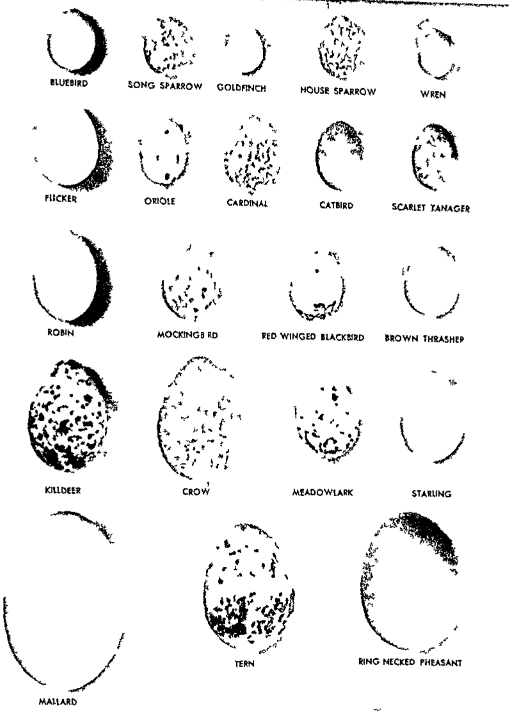
The bird's egg, of which the hen's egg is typical, has been called "the most perfect thing in the universe." On the outside is the shell, composed chiefly of calcium, covered with a thin skin (cuticle). Inside the shell are two membranes. One of them clings to the shell, the other to the albumen, or "egg white." Then come four concentric layers of albumen. Finally, in the center of the egg is the yolk, enclosed in a thin yolk sac (vitelline membrane). The yolk consists of six layers of yellow yolk alternating with six layers of white yolk.

In the core of the yolk is a vase-shaped mass of white material, the "latebra." It is connected by the neck of the vase with the germinal disk (blastodisk) on the outer surface of the yolk. From it de-

THE PARTS OF A HEN'S EGG



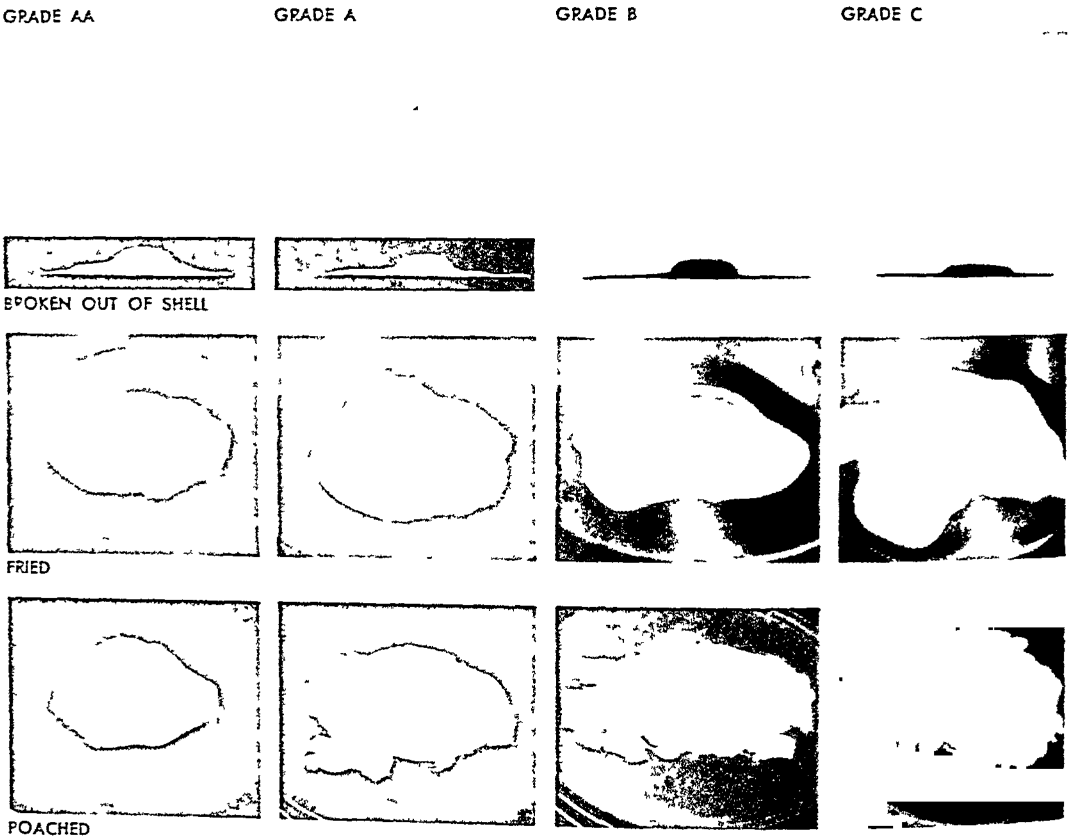
The yolk is a very important part of the egg. It cradles the germinal disk (blastodisk) from which the embryo chick develops and it provides the embryo with the food materials necessary for its development. Outside the yolk are the albumen, or "egg white," and finally the shell. Each part is built in a series of concentric layers, and each is enclosed in protective sheaths. The chalazas are twisted strands of fiber which help to hold the yolk in the center of the egg. They are attached to the albumen at one end and to the yolk sac at the other.



THE EGGS OF SOME FAMILIAR BIRDS

Eggs of some of the common birds are shown here Egg collect ng is now forbidden by federal laws which protect songbirds They should never be taken from the nest As a rule eggs that are la d in holes or n hollow trees are wh te Those that are laid n exposed places have the protective colorat on of spots and streaks wh ch blend into the background and make them almost inv s ble

HOW TO KNOW THE QUALITY OF THE EGGS YOU BUY



Standards for egg quality, based on the average for each class, have been worked out by the Poultry Branch of the Production and Marketing Administration, United States Department of Agriculture. These standards are as follows: "AA" egg covers a small area; the white is thick and stands high; the yolk is firm and high "A" egg covers a moderate area; the white is reasonably thick and stands fairly high; the yolk is firm and high. "B" egg covers a wide area; has a small amount of thick white; the yolk is somewhat flattened and enlarged. "C" egg covers a very wide area; the white is thin and watery; the yolk is flat, enlarged, and breaks easily. The Department recommends that eggs be kept in the refrigerator to protect their quality.

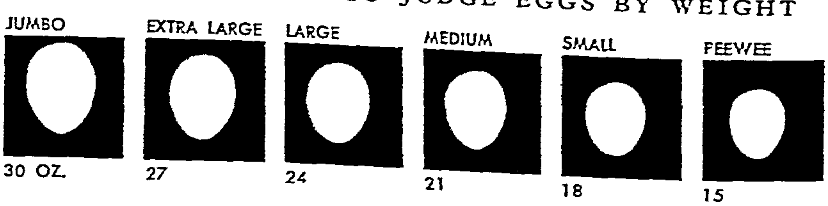
velops the embryo chick. Along the long axis of the egg are twisted ropy strands of fiber, the chalazas. When the egg is turned, the strands twist and tighten and hold the yolk to the center.

Between the egg membrane and the shell membrane, at the blunt end of the egg, is an air cell. It forms *after* the egg is laid. The chick's head lies directly below the cell and apparently its purpose is to provide air when breathing first begins The yolk is formed in the hen's ovary. In the oviduct, the passage down which the egg moves, the yolk receives the albumen, the two shell membranes, and the shell. Usually but not always the egg is laid small end first.

About 74 per cent of the weight of an egg is water; proteins and fats total about 12 per cent each; carbohydrates one per cent, and minerals one per cent. Most of the food materials are in the yolk. The egg contains nearly all the known vitamins and is an excellent source of vitamins A and D.

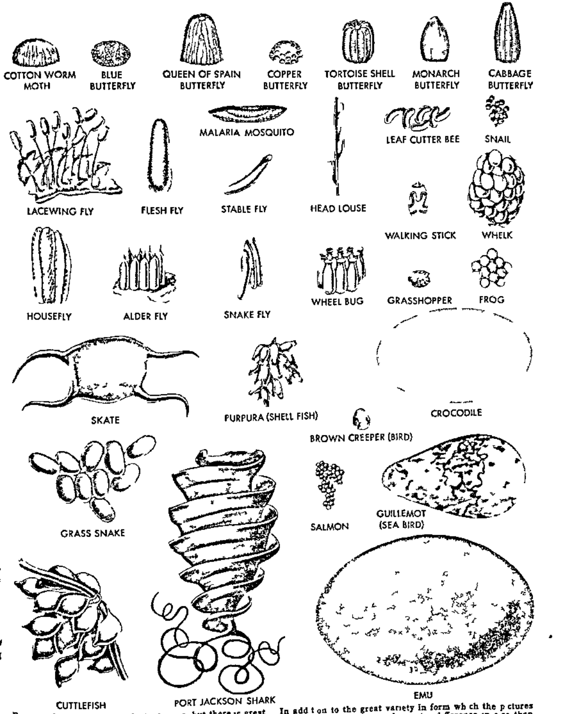
Besides hens' eggs, men eat the eggs of ducks, geese, and guinea fowls; and, in some countries, they eat the eggs of sea birds and turtles. Fish eggs, called "roe," salted and prepared as "caviar," are prized as food the world over. (*See also* Cell; Embryology; Poultry.)

HOW TO JUDGE EGGS BY WEIGHT



The United States government's standards show the minimum weight per dozen for each class of egg.

EGGS TAKE MANY STRANGE FORMS



Everyone knows the shape of a bird's egg but there is great variety among the eggs laid by other creatures such as the insects reptiles and fish Some look like milk bottles others like flower buds at the tips of stems Many are like bunches of grapes or clusters of strange fruit Eggs may be laid singly or in sticky masses held together by a gelatinlike material

In addition to the great variety in form which the pictures show there is also a much greater difference in size than appears in the pictures The egg of the emu for instance is about six inches long and weighs nearly three pounds while most of the insect eggs are no bigger than a pencil point and some can be seen only under a microscope

EGYPT—*The* LAND *and the* PEOPLE

This is the famous river Nile Without its life-giving waters, all Egypt would be a desert. The sailboats are called *feluccas.* They have very tall sails so that they can catch the wind that blows over the top of the cliffs Going downstream they drift with the current.

EGYPT. The world's largest and hottest desert stretches across all north Africa Egypt occupies the northeast corner of this desert. It has no more rain than the vast empty Sahara to the west The air is hot and dry. But down through the land there runs a green valley, watered by the river Nile. This is the real Egypt. Here the people live, crowded close together. The rest of the country is almost all wasteland.

Egypt is very old. The many pyramids that stand in the desert are the tombs of kings who ruled here 45 centuries ago. Then, as now, the Egyptians dug canals to carry the water of the Nile to their farms. The Egyptians today still use tools and water-lifting machines invented by their early ancestors.

It is often said, "Egypt is the gift of the Nile." But the Nile alone did not make Egypt. The people and the river together created the Egyptian landscape.

The Land THE MAP of Egypt shows a country almost square. It measures about 680 miles from north to south and 670 miles from east to west. Its area is about 386,000 square miles—more than three times the size of California.

The western boundary runs straight south through the Libyan Desert. The southern boundary marks off Egypt from the Anglo-Egyptian Sudan. To the east lies the Red Sea; to the north, the Mediterranean. The famous Suez Canal connects these two seas. It cuts through Egypt's territory; for the Sinai Peninsula, east of the canal, belongs to Egypt. Sinai lies in Asia and gives Egypt a border with Israel.

A limestone plateau underlies the sand and gravel of the desert Along the Red Sea the plateau rises to steep mountains with some peaks more than 7,000 feet above sea level In the north the land slopes down to the Mediterranean.

The land east of the Nile Valley is called the Arabian Desert after the great desert in southwest Asia. Here and in the dry Sinai Peninsula grow coarse grasses and scattered shrubs. The Libyan Desert, west of the Nile, is the driest part of the Sahara (*see* Sahara) Even camels cannot cross its great dunes of shifting sand. In a few places water comes to the surface or can be reached by wells. The people use this water to irrigate the land. Such irrigated places in a desert are called *oases.* There are five small oases west of the Nile.

The World's Largest Oasis

Through the limestone plateau the Nile has cut a level valley 800 miles long. Cliffs of brown and yellow rock rise like a wall on both sides of the valley. The irrigated land is from 10 to 15 miles wide. Between this green strip and the cliffs the ground is stony and sandy. A branch of the Nile—the Bahr Yussuf—flows through a gap in the western cliffs and waters a large fertile area called the Fayum.

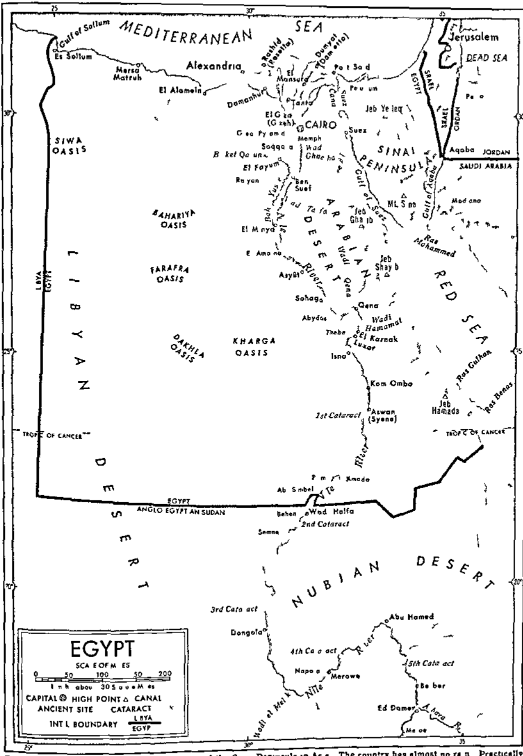
About 80 miles from the Mediterranean the Nile divides into two branches called the Rosetta and the Damietta. The cliffs disappear and the valley opens out like a fan into a wide *delta.* This broad plain is the most fertile part of Egypt. Its soft deep soil like that in the upper valley, was brought down by the Nile from highlands far to the south in Ethiopia

Extent.—Greatest length, north to south, 680 miles; east to west, 670 miles. Area about 386,000 square miles Population (1947 census), 19,087,304 With Great Britain, rules Anglo-Egyptian Sudan, about 967,500 square miles, population (1949 est.), 8,309,663

Natural Features.—Desert plateau, rising to mountains along Red Sea and in Sinai Peninsula; highest point, Mount Sinai, 8,652 feet. World's largest oasis, the irrigated delta and valley of the Nile River.

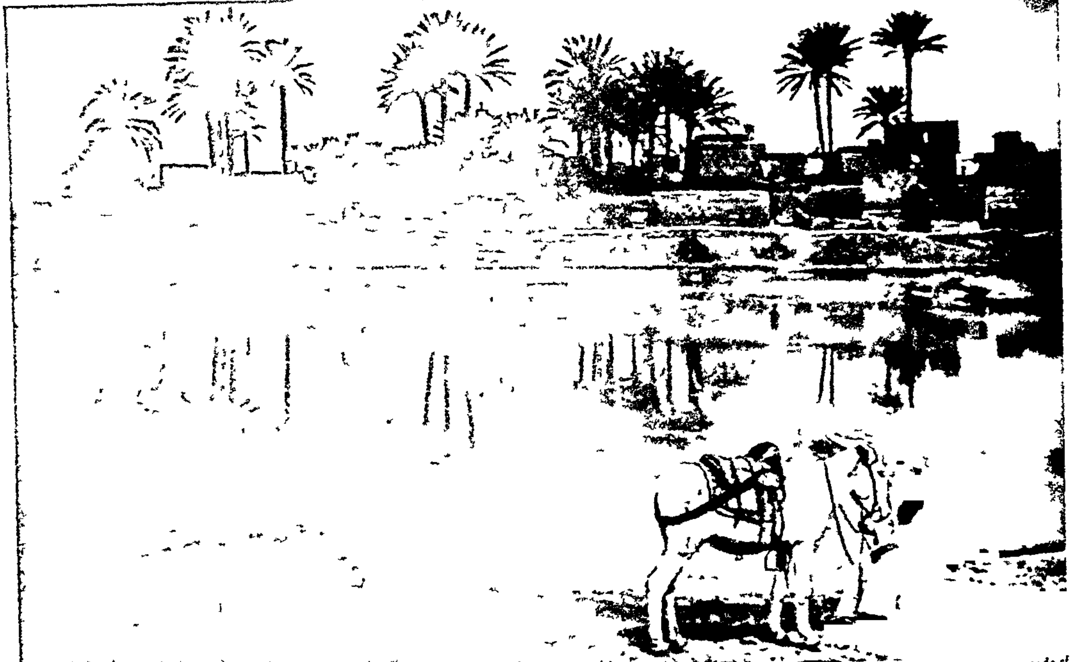
Products.—Cotton, corn, wheat, sugar cane, rice, onions; oil, manganese, phosphates, building stone; salt, cement; textiles, cigars and cigarettes; sugar refining; oil refining; chemical fertilizers

Chief Cities (1947 census).—Cairo (capital, 2,100,506), Alexandria (925,081), Port Said, Tanta, Mahalla el Kubra, Suez, Mansura (over 100,000).



Egypt occupies the northeast corner of Africa and the S nai Peninsula in As a The country has almost no ra n Practically all the people live in the irrigated valley of the Nile and in the Nile Delta which has deep alluvial so l

DATE PALMS SHADE THE FARM VILLAGE



Egyptian farmers live in small villages. Their little houses are the color of the ground they stand on because they are made of mud. An overflowing canal has spread an unhealthful marsh around this village. The man is sitting on the edge of a mud-brick bin filled with clover and is feeding the clover to his donkey.

Every year in midsummer the Nile used to overflow its banks. When the water drained away, the people planted their crops. They could raise only one crop each year. Today Egypt has a modern irrigation system. A great dam at Aswan, in southern Egypt, holds back the flood water and lets it out as it is needed. Farther down the river, barrages raise the river level and force the water into irrigation canals. Water is now available the year round. This makes it possible to raise three crops a year in the warm climate.

The delta is called Lower Egypt. The narrow river valley is Upper Egypt. Their irrigated land is the world's largest oasis. Together with the small oases, they cover 13,500 square miles. This is less than 3 per cent of Egypt's area.

A Land of Brilliant Sunshine

The extreme south of Egypt lies in the tropics. The rest is in about the same latitude as Florida. Summer and winter, the sun shines bright in a cloudless sky. The wind is almost always from the north. It brings rain to Lower Egypt in winter, but it becomes very dry and hot as it moves south. In Upper Egypt many children have never seen rain, for 10 or even 20 years may pass without a shower in their village. When rain does come, it is usually a deluge.

In spring, for two or three days at a time, a hot dry wind from the south blows up thick yellow clouds of dust and sand. The wind is called the *khamsin*.

The People THE EGYPTIANS today look much like the pictures of their early ancestors. They have the same handsome straight nose, black eyes, thick long eyelashes, and rather delicate bodies. Those in the north generally have light yellowish skin. In the far south the people are browner.

Egyptians speak the Arabic language. Most of them also follow the Arab religion, called *Islam*. Every town and village has its mosque, or temple. From the minaret, or tower,

CARRYING WATER FROM THE NILE

The girl in black is a young married woman. She can balance her water jar on her head without touching it. The younger girls have not yet learned how to do this.

muezzin calls the people to prayer five times a day (*See also* Islam Mohammed)

Every town and city has also a group of Christians called *Copts* The Coptic church is one of the oldest Christian churches In the larger cities live many Greeks Armenians Syrians Italians Jews French and British Dark skinned Nubians live in the far south Nomad Arab tribes pasture their herds in the Arabian Desert All these people enjoy the same rights The Egyptians are kindly courteous people and they learned long ago to tolerate other religions and to live at peace with the strangers who settled among them

In a hundred years the population of Egypt has grown from about 3 million to more than 19 million There are now about 1 400 persons for every square mile of farmed land Three out of five families live on farms

GOING HOME FROM THE FIELDS

The girl is riding on a water buffalo She sits on some green clover which the buffalo will eat for his supper Her father has been planting wheat and is bringing back in a bag the seed he had left over

Farm Life THE EGYPTIAN peasant is called a *fellah* The word means one who tills the soil The fellahs are very poor A family must get all its living from one or two acres Only a few own the land they farm The rest must pay rent to a landlord Some landlords own many thousands of acres

The fellahs live in villages Because land is precious they build their houses close together on narrow lanes There is no space for grass or gardens but every village has palms which give both dates and shade

There are no forests in Egypt So the fellah builds his house with mud The brick maker mixes the mud with wheat straw to make it strong and packs it in wooden boxes to shape it The bricks soon become hard in the hot dry air To hold the bricks together the builder uses more mud and straw When the walls are up he lays split palm trunks across them and covers these with palm branches or cornstalks and mud The roofs are flat because they do not need to shed rain The thick walls keep the house warm in winter and cool in summer

The richer landowners build houses two or three stories high The fellah s hut has only two rooms One room is for the farm animals the other is for the family People and animals use the same door Windows are small openings with wooden shutters and no glass The floor is packed earth

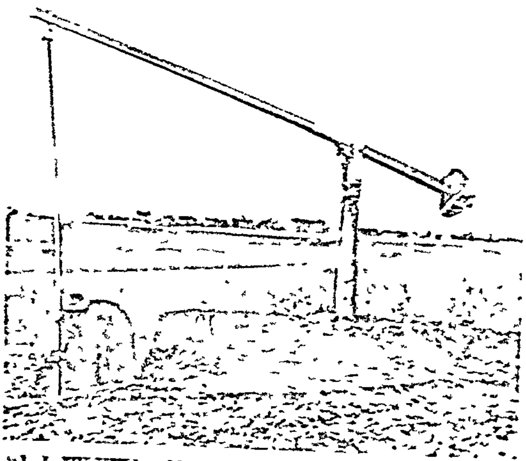
Across one end of the room is a large built-in oven made of mud brick It has a small oval opening in front for cooking and baking The smoke goes out through a hole in the roof The top of the oven is covered with a straw matting Here the whole family sleeps In winter they build a fire to warm the bricks before they go to bed For fuel they use cornstalks or the dried brush of cotton plants In summer the housewife does most of her cooking on a small brick oven out of doors

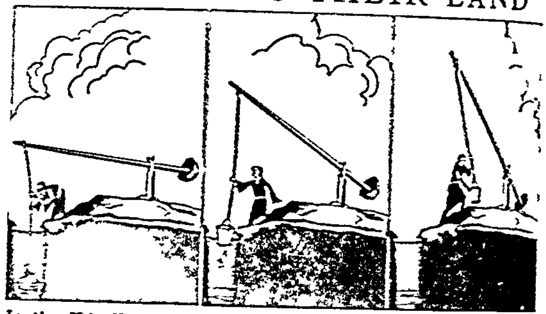
The only furniture is a wooden box chest for clothing The family sits on the floor to eat Corn and wheat are stored in brick bins In a corner stands a large earthenware water jar It is the housewife s duty to keep this filled In other jars she keeps

THEY USE STONES FOR CHECKERS

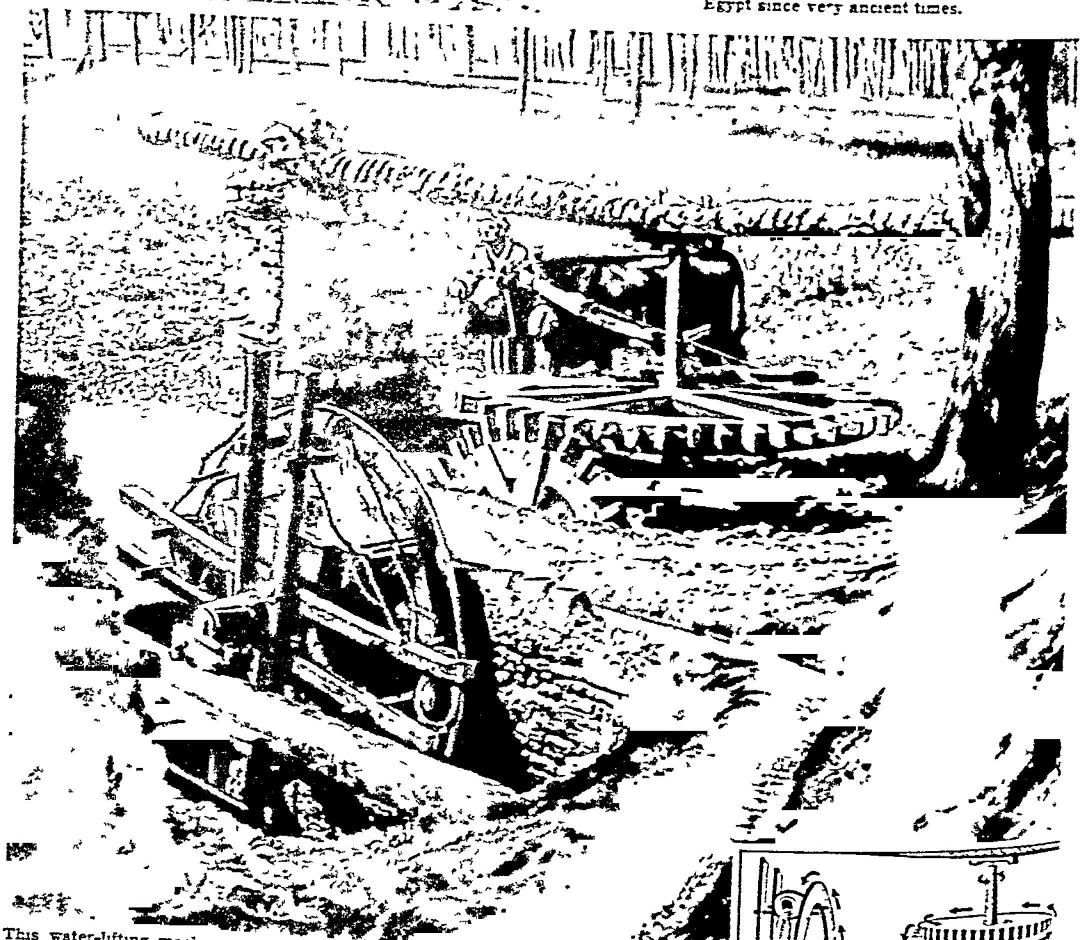
Young and old in Egypt like to play *checkers* Usually they make a checkerboard by scratching lines on the ground These people are using a rock for a table The young girl is watching the man and woman play

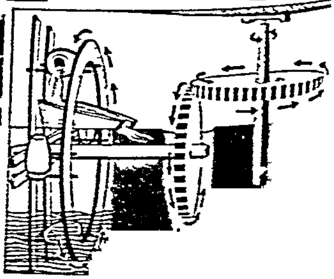
HOW THE FARMERS LIFT WATER UP TO THEIR LAND





In the Nile Valley the farmer has to dig down only a few feet to reach water. But after he has dug a well, he must work hard to lift the water up to his rich soil. This farmer is using a simple water-lifting machine called a *shadoof*. A leather bucket hangs from one end of the cross pole. At the other end is a lump of mud. The mud lump is very heavy. The farmer has only to loosen his hold on the rope and let the mud weight pull up the bucket. Then he swings the bucket away from the well and empties it into a ditch. The shadoof works something like a seesaw. It has been used in Egypt since very ancient times.





This water-lifting machine is called a water wheel, or *sakia*. All the boy has to do is to keep the oxen moving. The oxen are blindfolded so that they cannot see anything that might scare them. If they did, they would run and break the wheel. They are yoked to a shaft attached to the flat wheel. As they walk, they turn this wheel round and round. Cogs in the flat wheel fit into cogs in another wheel and make it turn also. This second wheel is on the same shaft as the water wheel, so that both turn together. The photograph shows only the part of the machine that is above the ground. The diagram shows what is under the ground also. In the diagram you can see how the jars on the water wheel fill when they pass through the water and how they empty when they go around the top. A trough carries the water off into a ditch.

salted cheese or salted vegetables—green peppers cucumbers turnips or onions With these she can serve a quick cold lunch For dinner she makes a vegetable stew The fellah is too poor to afford eggs and milk and he eats meat only on feast days He usually keeps a water buffalo which gives good milk But he sells the butter that he makes from the rich cream With the skimmed milk that is left the housewife makes salted cheese for the family This is eaten every day She raises a few chickens on the roof but she sells both chickens and eggs

TOO MUCH WATER HERE

The man on the right is digging a new ditch to make the water flow away from his young fig trees The man on the left is piling up mud to block the old ditch

Work and Play on the Farm

Before sunrise the village is nearly emptied All except the very old go to the fields With them go their work animals—water buffaloes oxen and donkeys The farm implements are loaded on the animals—usually a wooden plow with iron tipped share a simple hand sickle and a hoe

The people are barefooted because they will have to wade through canals and ditches The children wear cool cotton dresses The fellah wears a long white robe called a *galabia* and a small cap His wife covers her bright colored house dress with a long black *galabia* and puts a black veil over her head and face but she takes off these outer garments as soon as she reaches the farm Married women must wear the black coverall except when they are with their families or close friends

A sunny path along a canal leads to the farm The farm is about the size of a city block It is crisscrossed with ditches that carry the canal water to the soil

Often the canal water is too low to feed the ditches Then the fellah must lift the water to his land The commonest water lifters are the water wheel called a *sakia* and the water lift called a *shadoof* (See pictures on the opposite page) *If part of the* farm has thin soil the fellah carries rich soil to it in a large basket

In early spring the fellah usually plants cotton sugar or corn Cotton is Egypt s most valuable crop Under the hot summer sun each acre of cotton needs almost 20 tons of water a day Four times during the summer the cotton must be picked The average yield is about 600 pounds an acre—double that of the United States

At the end of the summer the fellah usually plants corn and clover The clover called *berseem* feeds his animals He dries some of it for summer feed since he cannot spare land in summer for pasture In November he plants wheat and barley On his small farm he also finds space to raise vegetables for his family

Children who are too young to work join with the neighbors children in play The girls like to play

COTTON PICKERS AT WORK IN THE DELTA

The whole family works hard in cotton picking time They go over the field four times Each time they pick only the fluffiest bolls leaving the rest to ripen on the plants

house. The boys prefer to play farm. They dig small ditches, let the water run in, and make a shadoof; then they argue, as they have heard their fathers argue, and sing the songs that set a rhythm for the labor.

At noon, when the sun is hottest, everyone stops work. This is a time for prayer. The people are far from their village mosque. But under a group of palms they have a prayer place covered with straw instead of a prayer rug. They always wash before praying Then they eat the lunch they brought with them. After lunch both people and animals lie down and sleep for an hour or longer. At sunset they quit work and set out for home.

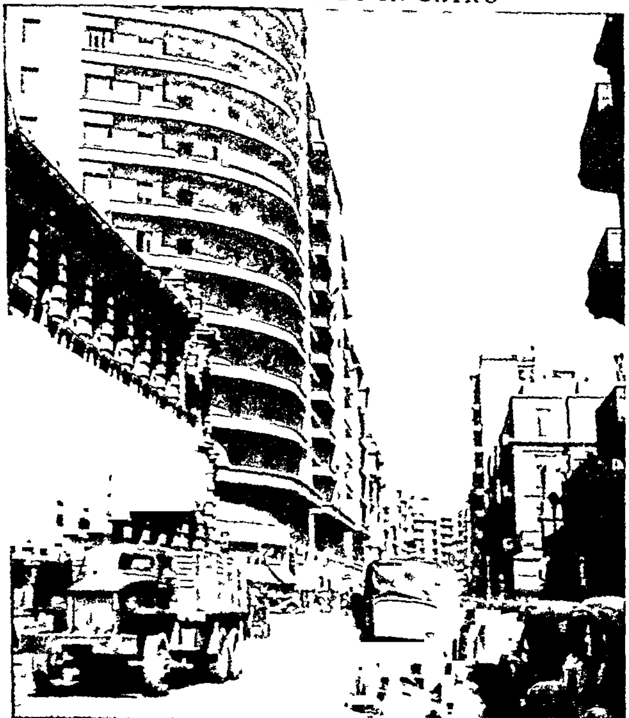
IN THE OLDER PART OF CAIRO

The girl is watching the potter make a jar. He puts the clay on his potter's wheel and works a foot pedal to make the wheel go round. As the wheel turns he shapes the wet clay with his hands.

Disease Saps the People's Energy

After dinner the women sit on mud-brick benches in front of their houses and talk. The men gather in separate groups Soon they are all in bed, for they are tired after the long day's work. They are also undernourished; and four out of five suffer from parasitic diseases spread by the muddy Nile water. One of these diseases is hookworm, the "lazy disease" (see Hookworm). The other, *bilharzia*, is caused by a worm that lives on a snail in stagnant water. Malaria also is common and there are many blind people. Most villages now have health centers, and the larger towns have free hospitals. But the parasitic diseases need to be attacked at their source—in the Nile water.

A MODERN STREET IN CAIRO



The newer part of Cairo has wide streets lined with department stores, office buildings, and apartment houses. Some buildings are air-conditioned.

Traveling to Market

The villages lie only two or three miles apart. For every five or six villages there is a central market The roads are too poor for automobiles or busses. The fellah loads his donkey with the cotton or grain he has to sell and walks beside it. His wife carries on her head a wide shallow basket filled with butter, cheese, or vegetables. In the open-air market the village artists display their wares. The potter sits among his food jars and water coolers. The basket weaver sells mats woven of palm leaves and rushes, heavy baskets for carrying soil, and light market baskets. Local weavers offer handmade shawls and blankets. Metalworkers display ornaments and utensils made of silver, gold, and brass. Here and there people gather in groups to listen to professional singers and storytellers or to watch magicians and dancers.

City Life THERE ARE many flourishing towns in the delta and on the Nile, but only two great cities. Cairo, the capital, is the largest city in all Africa. It lies a few miles south of the delta and spreads over both banks of the Nile (see Cairo). On the Mediterranean is Alexandria Egypt's chief port and cotton market (see Alexandria). The Suez Canal made international ports of Suez, at the south entrance and Port Said, at the north entrance.

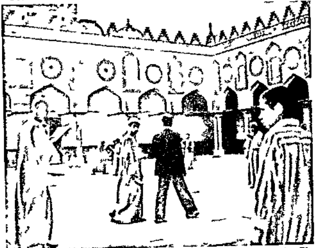
In Cairo and Alexandria, old and new stand side by side. Wide boulevards are lined with fine shops, hotels, business houses, and blocks of apartments. In narrow lanes stand close-packed tenements and open

fair bazaars where merchants display their wares in front of tiny shops The educated Egyptians speak French as well as Arabic and have adopted French manners They dress much like Westerners except that the men wear a red tasseled cap called a *fez*

Education THE GOVERNMENT of Egypt began a tremendous program of education in 1944 Up to that time only religious schools were free In these schools children studied little but the *Koran* the Islamic Bible The only university open to them after their religious training was the mosque El Azhar in Cairo At this famous ancient university they continued to study the Koran and Islamic law

By 1950 the state had provided free schools for children of the poor Education was made compulsory up to the age of 14 and secondary schools were free The new schools are modeled on those of America and Europe Good food is provided for children of the poor Boys go to school in the morning girls in the afternoon

THE RELIGIOUS CENTER OF THE ARAB WORLD



The famous mosque El Azhar in Cairo a half church and half university The students in this courtyard are studying the Koran the Islamic Bible For a thousand years El Azhar has been the center of learning for the Arab world

Egyptians must learn a new language when they learn to read The language in their books and newspapers is an early form of Arabic and is different from the language the people speak today For this reason and because illiteracy is still widespread many people depend on the government-owned radio for their news

Transportation RAILWAYS RUN up the Nile Valley and branch lines connect most of the towns in the delta But the bulk of the country s heavy goods still moves on the Nile River and the canals The north wind carries flat-bottomed sail boats called *feluccas* up the river There they are loaded with cotton grain or sugar cane Then they drift downstream with the current Sometimes the boatmen have to take to the towpath and pull their boat with ropes Passenger steamers also ply the Nile from Cairo to Aswan There are few highways for motor traffic The camel is still the chief means of travel to the oases and the Red Sea

An Egyptian airline furnishes regular service to the chief cities of Egypt and the Middle East Suez has more traffic than the Panama Canal (*see* Suez Canal)

Products COTTON IS the main source of wealth Egyptian cotton is an excellent long staple variety commanding a high price in world markets Other leading crops are corn wheat sugar cane (raised in the far south) and rice (grown in the delta)

The chief mineral resource is oil found in Sinai and along the Red Sea coast Sinai also has low grade manganese ore and nitrates and phosphates used as fertilizers Granite is quarried near Aswan and limestone and sandstone from the cliffs bordering the Nile Salt is obtained from Lake Mareotis in the delta Egypt has no coal Iron-ore deposits are said to be extensive but have not been exploited

The chief manufacturing industry is the spinning and weaving of cotton rayon and wool The largest plant is at Mahalla el Kubra in the delta Diesel engines run the machinery Other important industries are cigarette manufacture sugar refining and other food processing Suez has an oil refinery Near Suez a modern plant produces chemicals and fertilizers

Four fifths of Egypt s exports are cotton and its by products seed oil and cake Egypt also exports rice onions and oil The chief imports are wheat machinery and vehicles kerosene textiles tea coffee tobacco and wood

Government EGYPT became an independent kingdom in 1922 when the British ended their protectorate In July 1952 Maj Gen Mohammed Naguib seized power banished King Farouk and became a military dictator On June 18 1953 he proclaimed Egypt a republic and named himself president and premier The proclamation ended King Farouk s dynasty and meant that Farouk s infant son Fuad II was no longer the nominal king of Egypt

The government announced it would hold a popular referendum to determine whether the people wanted a presidential republic like the United States or a parliamentary form of republican government like that of France with a president and a premier

History THE HISTORY of ancient Egypt is told in a separate article (*see* Egypt Ancient) That history ends in the early Middle Ages when Egypt fell to the Arabs After the Arab conquest the Egyptian language passed out of use The Egyptians today speak Arabic and follow the Arab religion *Islam* (*see* Islam) Egypt is regarded as an Arab state

Mohammed prophet of Islam conquered all Arabia before his death in A D 632 (*see* Mohammed) His successors the califs carried the ' holy war to north Africa In 639–41 they conquered Egypt

The Egyptians at this period were Christians The Arabs wanted to convert all peoples to their new

religion. Most of the Egyptians in time accepted Islam. Some held out, despite persecution, and their descendants have remained Christians down to the present day. These people are called *Copts* from the Arabic word Kubt, meaning "Egyptian." They refused to intermarry with Moslems and kept alive their ancient Coptic church.

The Arabs set up their capital at Cairo in 969. They lived luxuriously and taxed the Egyptian peasants heavily. But they also built beautiful mosques and encouraged art and literature. The university El Azhar, which they founded, is still a center of Mohammedan learning.

Arab rule ended when the Turkish sultan, Selim I, conquered Egypt in 1517 (*see* Turkey). Turkish rule was weak and corrupt.

Egypt Becomes a British Dependency

Napoleon led an expedition of 300 vessels to Egypt in 1798. He aimed to win Egypt and then build a French empire in the Middle East. He defeated the Turkish army in the battle of the Pyramids. But the English discovered his ships in the harbor of Alexandria, and Admiral Nelson destroyed them in the famous battle of the Nile (*see* Napoleon; Nelson).

Both the English and French left Egypt in 1802 and the country reverted to anarchy. Relief came through Mehemet Ali, an Albanian officer in the service of the Turkish sultan. He seized power and proceeded to build up a strong Egyptian army. The sultan of Turkey was forced to recognize him as governor (*pasha*) in 1805.

Mehemet Ali repaired and improved irrigation systems and reclaimed thousands of acres from the desert. He gave each fellah a portion of land, supplied seed and farm animals, and encouraged the raising of cotton, sugar cane, and rice. In 1819 he sent an expedition up the Nile into the Sudan and built a capital there, Khartoum (*see* Sudan).

In 1856 Said Pasha, Mehemet Ali's son, granted a French company the right to construct the Suez Canal through Egyptian territory. The canal was opened in 1869 with elaborate ceremony during the reign of Ismail. Ismail was a spendthrift. He borrowed heavily from French and British bankers and spent the money lavishly on palaces, gardens, and hotels in Cairo. When he was unable to repay his loans, he sold Egypt's shares of canal stock to the British government for about 20 million dollars. The canal thus passed to British control (*see* Suez Canal). Ismail was soon in debt again. In 1876 he agreed to allow British and French officials to supervise Egypt's finances. In 1882 the Egyptians revolted and tried to get rid of the foreigners. The French withdrew. The British navy bombarded Alexandria and a British army occupied the country. Egypt thus became virtually a British dependency while still a part of the Ottoman Empire.

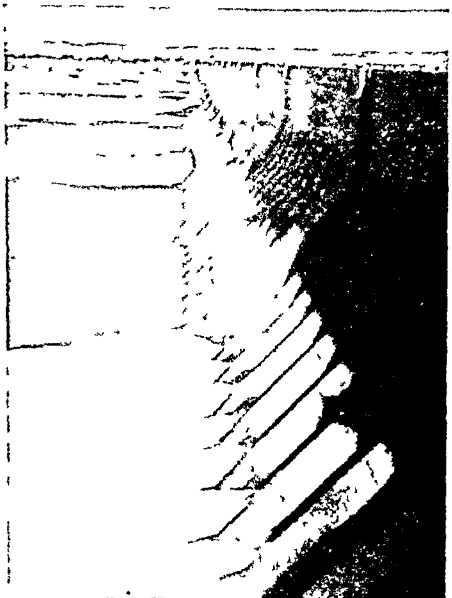
Egypt prospered under the guidance of British advisers. They restored financial order, reduced taxes and developed industry and commerce. They also constructed irrigation works, including the great Aswan Dam (completed in 1902). After a long struggle, British forces put down a rebellion in the Sudan. In 1899 the Anglo-Egyptian Sudan was established under the joint rule of Great Britain and Egypt (*see* Sudan)

When the first World War broke out, Egypt was still a part of the Ottoman Empire. The Turks sided with Germany. Egypt threw in its lot with Britain. In October 1914, Britain declared Egypt free from the Turks and formally proclaimed it a British protectorate.

Nationalists Demand "Egypt for the Egyptians"

After the war, the nationalist Wafd party led a movement for Egyptian independence. Disorders became so serious that the British in 1922 declared their protectorate at an end and recognized Egypt as an independent, sovereign state, but they reserved the right to keep troops there. In 1923 Egypt set up a constitutional government with Fuad (formerly sultan) as king. Fuad was succeeded by his son, Farouk in 1936.

WHEN THE GATES AT ASWAN ARE OPENED

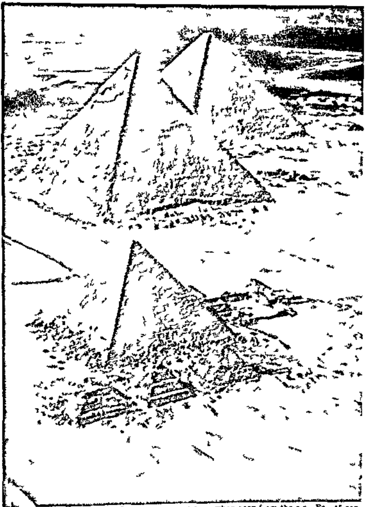


From March through the summer these gates are open to water summer crops. In November they are closed so that the Nile can fill the giant Aswan reservoir.

In 1936 Egypt signed a treaty of alliance with Britain for 20 years. The pact let Britain set up a military base on the Suez Canal and recognized Britain as joint ruler of the Sudan. In the second World War Egypt was neutral but allowed Britain and the United States to station troops there and use Alexandria as a naval base. In 1948 Egypt joined the Arab states in the war against Israel. After the war, Egypt kept possession of the Gaza coast (*see* Israel).

A bloodless revolution took place in 1952 when Gen. Mohammed Naguib forced King Farouk to abdicate and leave the country. Naguib assumed dictatorial powers and began at once to put through much needed political and land reforms. In 1953 Egypt and Britain signed an agreement giving the Sudanese the right to decide in three years whether they would join Egypt, join the British Commonwealth, or set up an independent state. (*See also* Sudan; Suez. For Reference-Outline and Bibliography, *see* Africa).

The Story of ANCIENT EGYPT



The three great pyramids of Gizeh are massive even when seen from the air. For 45 centuries they have proclaimed the wealth and power of the kings of ancient Egypt

EGYPT ANCIENT. No other country—not even China or India—has such a long unbroken history as Egypt. Three thousand years before the birth of Christ the Egyptians reached a high stage of civilization. They lived under an orderly government, they carried on commerce in ships, they built great stone buildings, and most important of all, they had writing.

Because they lived so long ago the Egyptians had to find out for themselves how to do things that we find quite easy today. Other early civilizations—particularly that of Babylonia—have a claim to be first with some inventions. But Egypt supplies us with much more evidence of their use. In the Nile Valley we can trace the development of arts and crafts that later found their way to Europe and formed the foundation of our own civilization.

The traveler up the Nile sees at almost every bend in the river majestic monuments that proclaim the glory of ancient Egypt. Most of these monuments are tombs and temples.

The ancient Egyptians were very religious. They believed in a life after death—at least for kings and nobles—if the body could be preserved. So they carefully embalmed the body (*see* Mummy) and walled it up in a massive tomb. On the walls of the tomb they carved pictures and written inscriptions. In some private tombs they painted pictures. They put into the tomb the man's statue and all sorts of things they thought he would want in the next life. The hot sand and dry air of Egypt preserved many of these objects through the centuries. Thousands of them are now in museums all over the world. Together with written documents they tell us how people lived in Egypt thousands of years ago.

The desert sands have also preserved the remains of prehistoric people. By their side in the burial pits lie stone tools and weapons, carved figures, and decorated pottery. These *artifacts* give us a glimpse of life in the Nile Valley centuries before the beginning of the historical period.

Prehistory

LONG AGES ago the land of Egypt was far different from what it is today (*see* Egypt). There was rain. There was no *delta*. The sea extended far up the Nile Valley. The plateau on each side was grassland. The people of that early time lived by hunting and herding. They wandered over the plateau in search of game and fresh pastures and had no permanent home. They hunted with a crude stone hand ax and with the bow and arrow. The arrows were made of chipped flint. (*See also* Stone Age.)

Very gradually the rains decreased and the grasslands dried up. The Nile began to deposit silt in the valley and to build up the delta. The animals went down to the valley. The hunters followed them and settled at the edge of the jungle that lined the river

In the Nile Valley the people's way of life underwent a great change. They settled down in more or less permanent homes. And they progressed from food gatherers to food producers. They still hunted the elephant and hippopotamus and wild fowl, and they fished in the river. But more and more they relied for meat on the animals they bred—long-horned cattle, sheep, goats, and geese. They learned that the vegetables and wild grain they gathered grew from seeds. When the Nile flood drained away, they dug up the ground with a wooden hoe, scattered seeds over the wet soil, and waited for the harvest. They cut the grain with a sharp-toothed flint sickle set in a straight wooden holder. They ground it between two flat millstones. They raised emmer wheat, barley, a few vegetables, and flax. They made bread and beer from the grain, and they spun and wove the flax for linen garments.

KING KHAFRE

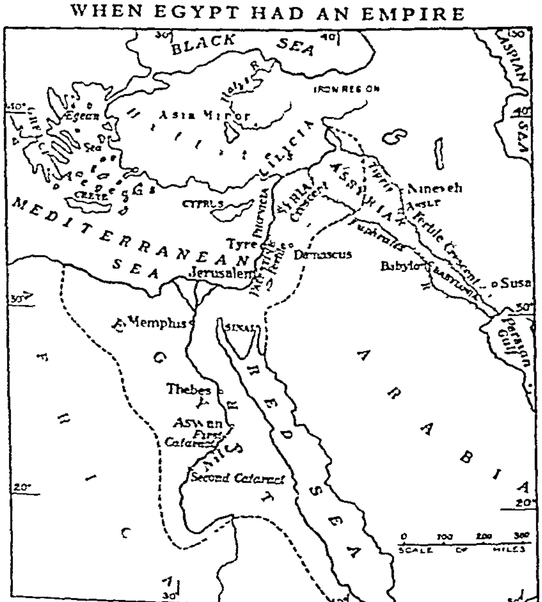
A falcon, symbol of the god Horus, protects the king with its wings. The head is part of a statue in the Cairo Museum.

The first houses were round or oval, built over a hole in the ground. The walls were lumps of mud and the roofs were matting. Later houses were rectangular, made of shaped bricks, with wooden frames for doors and windows—much like the houses the Egyptian farmers live in today. To work the lumber, the people used ground stone ax heads and flint saws. They made beautiful clay pottery, without the wheel, to hold food and drink; they fashioned ornaments of ivory, made beads and baskets, and carved in stone the figures of people and animals. They built ships with oars and carried on trade with near-by countries. The ships had simple signs instead of names, showing probably the home port. These signs were an early step in the invention of writing.

Good farmland was scarce. The desert came down close to the marshes that edged the river. To gain more land, the people rooted out the jungle, filled in marshes, and built mud walls to keep out flood water. Finally they engaged in large-scale irrigation work, digging canals that cut across miles of land. This required the cooperation of many people living in different places. Leaders were needed to plan the work and direct the workers. Because of this need orderly government arose. Population and wealth grew with the increase in farmland. There was food enough to support a professional class who worked at crafts instead of farming. Villages grew into towns. Large towns spread their rule over near-by villages and became states. At the end of the prehistoric period, there were only two political units. One was Lower Egypt, the delta. The other was Upper Egypt, the valley. In later times, when Egypt was united the people still called the country the Two Lands, and the king of all Egypt wore a double crown combining the white crown of the south with the red crown of the north.

Before the prehistoric period ended, the Egyptians were stimulated by contact with people who lived in another river valley in Asia (*see* Babylonia). These people were more advanced than the Egyptians in working metal. They also had writing. Perhaps the Egyptians got the idea of writing from them. But they did not take over the Babylonian script. They developed a script of their own. This great invention brought Egypt abruptly to the threshold of history; for history proper begins with written records.

WHEN EGYPT HAD AN EMPIRE



Around 1479 B.C., Thutmose III, riding "in a chariot of fine gold," led his armies out of Egypt into Phoenicia, Palestine, and Syria. In later campaigns he extended Egypt's empire to the valley of the Euphrates River. Earlier rulers had already pushed the frontiers south into Nubia, the land beyond the First Cataract.

Dynasties

WRITTEN records in Egypt go back to about 3100 B.C. Around this time the Two Lands were united in a single kingdom. According to tradition, it was Menes, king of Upper Egypt, who brought about the union. He stands first in the long list of kings who ruled Egypt for about 3,000 years. Egyptian priests made lists of their kings (*pharaohs*) and noted the most important events of their reigns. About 280 B.C. one of these priests, Manetho, grouped the pharaohs into 30 dynasties. (A dynasty is a line of rulers of the same family.)

Modern historians group the dynasties into periods. The period when Egyptian civilization flourished are th

Old Kingdom, the Middle Kingdom, and the New Kingdom. They are separated by periods of decline called the First and the Second Intermediate Period. The final period of decline is called the Late Period.

Old Kingdom WE KNOW little of the kings who followed Menes until we come to King Djoser at the end of the third dynasty. Djoser's capital was at Memphis, on the west bank of the Nile near the point where the Two Lands meet. Imhotep, a master builder, erected Djoser's tomb, the great step pyramid of Saqqara, on high ground overlooking Memphis. *This was the first great building in Egypt made entirely of stone.* It marked the beginning of Egypt's most creative period, the Pyramid Age.

Later kings built their tombs in true pyramid form. Each pyramid guarded the body of one king only, housed in a chamber deep within the pile. The climax of pyramid building was reached in the three gigantic tombs erected for kings Khufu, Khafre, and Menkaure. Near them in the sand lies the great stone Sphinx, a lion with the head of King Khafre. (*See also* Pyramids; Sphinx.)

The Old Kingdom lasted about 500 years. It was an active, optimistic age, an age of peace and splendor. Art reached a brilliant flowering. Sculpture showed a grandeur never later attained. The pharaoh kept a splendid court. The people worshiped him as a god on earth, for they believed him to be the son of Re, the great sun god. They called him *per aa* (in the Bible *pharaoh*), meaning Great House.

The Old Kingdom came to an end about 2200 B.C. Nobles became independent and ruled as if they were kings. The country was split up into small warring states. *Irrigation systems fell into disrepair.* Various writers of the time complained: The desert is spread throughout the land. The robbers are now in the possession of riches. Men sit in the bushes until the benighted traveler comes to steal what is upon him. Thieves broke into the pyramids and robbed them of their treasures.

Middle Kingdom THE MIDDLE KINGDOM period began about 2050 B.C. *After a* long struggle the rulers of Thebes won out over their enemies and united Egypt once more into a single

IN THE VALLEY OF THE TOMBS OF THE KINGS

This is the entrance to Tutankhamen's tomb. His mummy and the wealth of treasure in his burial chamber remained undisturbed until archeologists discovered the tomb in 1922.

state. Thebes was then a little town on the Nile in Upper Egypt. It grew to be a great capital, the most magnificent in the ancient world.

The pharaohs of the Middle Kingdom constructed enormous irrigation works in the Fayum. They noted the annual heights of the Nile flood at Aswan and laid plans to use the Nile water wisely. They sent trading ships up the Nile to Nubia and across the sea to Mediterranean lands. They got gold from Nubia and copper from the mines in Sinai. They began the construction of the most colossal temple of all time, the Temple of Amun at Karnak in Thebes.

After two centuries of peace and prosperity, Egypt entered another dark age. About 1800 B.C. it fell for the first time to foreign invaders. Down from the north came a barbarian people, the Hyksos. In fight*ing the Hyksos used horses and chariots.* They also had superior bows. The Egyptians, fighting on foot, were no match for them. (Up to this time the Egyptians had no horses or chariots.) The Hyksos *remained in Lower Egypt,* living in fortified camps enclosed with great earth walls. They failed to conquer Upper Egypt, and the pharaohs stayed on at Thebes. *Finally the Egyptians learned* the new methods of warfare. Under Ahmose I they started from Thebes a war of liberation and drove out the Hyksos.

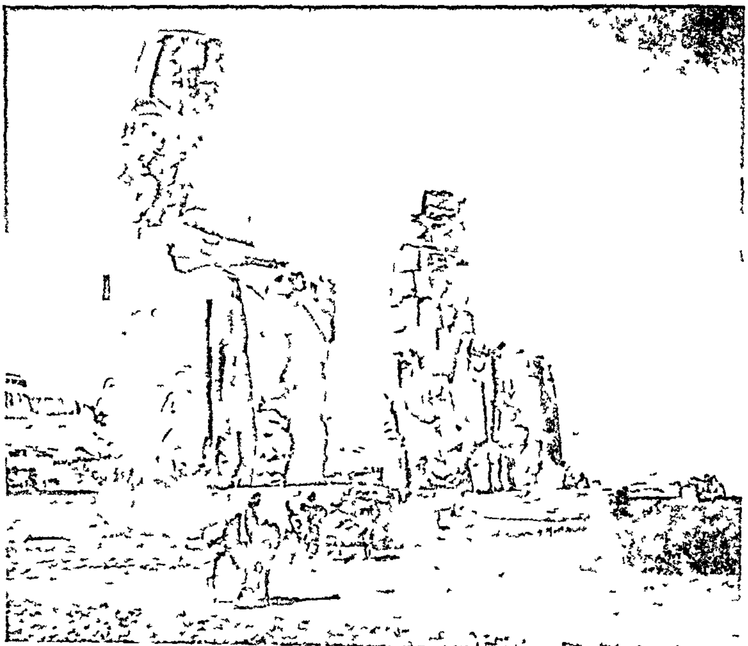
New Kingdom *A NEW ERA dawned for* Egypt after the Hyksos had been expelled. This period, the New Kingdom, was the age of empire, for *the formerly peaceful Egyptians,* having learned the art of war, embarked on for

CHIEF PERIODS IN EGYPTIAN HISTORY

Prehistoric Period	Before 3100 B.C.
Archaic Period (Dynasties I–II)	3100–2700 B.C.
Old Kingdom (Dynasties III–VI)	2700–2200 B.C.
First Intermediate Period (Dynasties VII–X)	2200–2050 B.C.
Middle Kingdom (Dynasties XI–XII)	2050–1800 B.C.
Second Intermediate Period (Dynasties XIII–XVII)	1800–1570 B.C.
New Kingdom (Dynasties XVIII–XX)	1570–1090 B.C.
Late Period (Dynasties XXI–XXX)	1090–332 B.C.
Ptolemaic Period	332–30 B.C.
Roman Period	30 B.C.–A.D. 395
Byzantine Period	A.D. 395–640

The dates are approximate until about 500 B.C. For the earliest period, around 3000 B.C., historians estimate the margin of error may be as high as 100 years. The margin narrows around 1000 B.C. to 10 to 15 years.

THE COLOSSI OF MEMNON



These colossal statues of King Amenhotep III are all that remain of his temple in western Thebes. *They were originally nearly 70 feet high and weighed over 700 tons each.* The Romans thought they were statues of Memnon, a hero of the Trojan war

eign conquest on a large scale. The empire reached its peak under Thutmose III, one of the first great generals in history. He fought many campaigns in Asia and extended Egypt's rule northeast to the Euphrates River.

Slaves and tribute poured into Egypt from the conquered nations. The tribute was paid in goods, for the ancient world still did not have money. Wall paintings show people from Nubia, Babylonia, Syria, and Palestine bearing presents on their backs, bowing humbly before the pharaoh.

The rulers used the new wealth and slaves to repair old temples and build new ones. Hatshepsut, Egypt's first great queen, enlarged the great Temple of Amun at Karnak. She also built her own beautiful temple at Deir el-Bahri.

Amenhotep III built the wonderful temple at Luxor and put up the famous pair of colossal seated statues called the Colossi of Memnon. In the Middle Kingdom period, the pharaohs of Thebes had built modest brick pyramids for their tombs. In the New Kingdom they broke with this tradition and began to hew tombs deep in the cliffs of an isolated valley west of Thebes. About 40 kings were buried in this "Valley of the Tombs of the Kings."

Amenhotep III, in the last years of his reign, paid little attention to the empire; and it was already decaying when his son Amenhotep IV came to the throne. This king was more interested in religion than in warfare. Even before his father's death, he began to promote a new religious doctrine. He wanted the people to give up all their old gods and worship only the radiant sun itself, which was called Aton. He changed his name from Amenhotep ("Amun is satisfied") to Akhenaton ("It is well with Aton"). He left Thebes and built a splendid new capital sacred to Aton at Tell el-Amarna, east of the Nile. Throughout the land he had the word "gods" and the name "Amun" removed from tombs and monuments.

Akhenaton's idea of a single god gained no hold on the Egyptian people. Tutankhamen, who followed him, moved the capital back to Thebes and restored the name Amun on monuments. Tutankhamen is famous chiefly for his lavishly furnished tomb, discovered in 1922. Its treasures reveal the luxury of the most magnificent period of Egyptian history.

Half a century later Rameses II completed the gigantic hall at Karnak and set up many statues of himself. He also had his name carved on monuments built by earlier rulers, so that he became better known than any other king. He regained part of Egypt's Asiatic empire. But the kings who followed him had to use the army to defend Egypt against invaders.

Late Period *IN THE LATE PERIOD* the final decline of Egypt's power set in. The treasury had been drained by expensive building projects and by the army. Hungry workers had to resort to strikes to get their wages in grain. The central government weakened, and the country split up once more into small states.

About 730 B.C. Ethiopians invaded Egypt and set up a strong new dynasty. But they were unable to resist invasion from the north by the Assyrians. When Assyria's power waned, a new Egyptian dynasty reorganized the country. The last Egyptian dynasty, the 30th, ended when Persia conquered Egypt in 525 B.C.

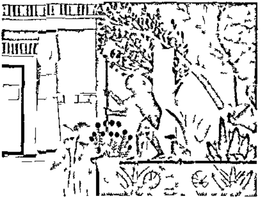
Persian rule lasted until Alexander the Great invaded Egypt in 332 B.C. After Alexander's death Ptolemy, one of his generals, seized the throne. The Ptolemies introduced into Egypt Greek manners and ideas. The city of Alexandria, founded by Alexander, became the center of Greek civilization in the Near East (*see* Alexandria). The last rulers of the Ptolemaic line were beautiful Queen Cleopatra and her son Ptolemy XIV (*see* Cleopatra). In 30 B.C., Rome declared Egypt a province.

When the Roman Empire was split in two, Egypt was ruled from Constantinople (*see* Byzantine Empire). During this period, the Egyptians became Christianized. Finally, in the 7th century, Egypt fell to the Arabs. (For the later history of Egypt, *see* the section "History" at the end of the preceding article, Egypt.)

Everyday Life in Ancient Egypt

WE LIVE today in an age when every year brings forth new inventions and fashions that affect our everyday life *The Egyptians had their greatest creative period at the very beginning of their long history* After that their way of living changed very little It is therefore possible to describe their home life and their art without reference to the historical periods of Egyptian history These periods are discussed in the earlier section of this article

Home Life OF ALL EARLY peoples the Egyptians were the least warlike Their country *was protected by the sea on the north and by deserts* to the east and west For many centuries they could develop their own way of life without fear of invasion by foreign armies Their interests were centred in their homes and families and in their work Their stone tombs were a kind of insurance against death They loved life and wanted it to go on forever

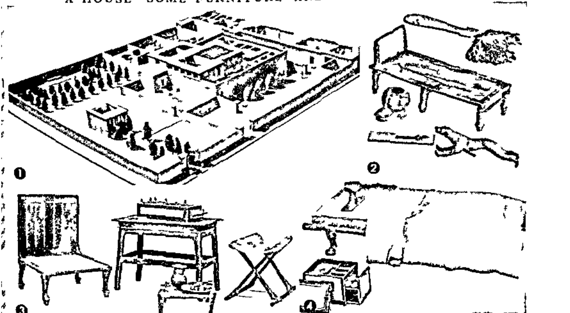


The gardener is lifting water with a *shadoof* Behind him sits his master's dog From a wall painting about 1250 B C

Villages and towns were situated near the Nile because it was the chief highway as well as the only *source of water Even the rich lived in houses made* of mud brick But inside and outside the house the walls were richly colored Windows were small high openings covered with loosely woven matting to keep out the heat and glare of the sun The most fashionable district was near the king's palace Even here the houses were crowded close together to leave more space for farmland Some were two stories high Usually two houses were built back to back to save space Some opened directly on the narrow street Others had a small walled garden in front

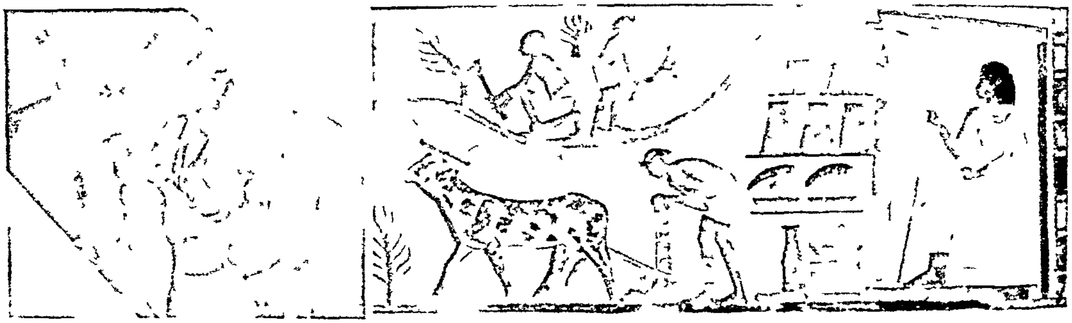
The walls were decorated with bright frescoes Straw matting and rugs covered the floors Lamps were saucers of oil with a floating wick Rich people had beds and chairs and stools but no real dining tables They kept their clothes and linen sheets in box chests or in baskets They marked their linen with the owner's name and sent it to professional laundrymen to wash it in the river They stored water and food in huge pottery jars

A HOUSE SOME FURNITURE AND CHILDREN S TOYS



1 The house is a model reconstructed from *ruins of a nobleman's* estate in Tell el Amarna 2 Long ago children played with this paddle doll with rope hair the jointed doll on the folding bed and the paintbox 3 On the table is a game *played* somewhat like chess 4 Beside the bed is a box of cosmetics The toys and furniture are in the Metropolitan Museum of Art

BAKING AND FARMING ON A LARGE ESTATE



The bakers are busy mixing and rolling dough for the many loaves needed on the estate. These small models in clay were made about 2000 B.C. The wall painting shows a woodcutter and farmers hoeing and plowing, while the overseer sits comfortably in the shade Their labor fills the bowls and baskets with food.

The cook used pottery bowls and placed them directly on the fire or in a clay oven She baked bread and cake and roasted beef, mutton goose, or wild fowl. (The Egyptians had no chickens) The common drinks were beer, wine, and milk Honey and dates were the only sweets. Almost everything the family needed was grown or made by workers on the estate

Dress THE UPPER-CLASS Egyptians spent a lot of time on their appearance They bathed with soda instead of soap and then rubbed perfumed oil into the skin. Men shaved with a bronze razor They cut their hair short and wore wigs made of sheep's wool. Women also wore wigs or added false braids to their own hair. They had combs and hairpins and mirrors of polished bronze or silver. Both men and women darkened their eyelids with black or green paint. Women rouged their cheeks and lips and stained their nails with henna. They kept their cosmetics in beautiful box chests.

Both men and women wore white linen clothes. Men usually wore only a skirt. In the early centuries the skirts were short and narrow; later they were long and full. Women wore low-cut white dresses with bands over the shoulders. Young children wore nothing at all. Both men and women wore jewelry —collars and necklaces, strings of beads, bracelets, anklets, earrings, and finger rings. Silver was more precious than gold.

The Workers THE LUXURIOUS life of the pharaoh and the nobles was made possible by the unending labor of the peasants who tilled the soil. After the crops were harvested the pharaoh could call on them to leave their village huts and go off to labor on irrigation works, to quarry stone with primitive tools, or to build tombs and temples. Their only pay was grain from the state granaries, oil, fish, vegetables and clothing.

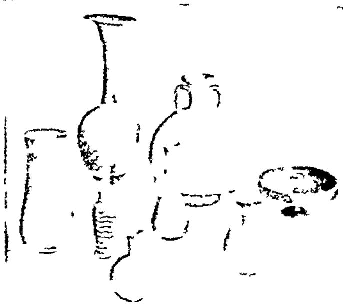
Craftsmen and artists had an easier life. They worked in shops close to the palace of the pharaoh or on the estates of priests and nobles. Their professions were hereditary, passed down from father to son. An artist was never hurried. If he could produce a masterpiece, it did not matter whether he worked on it one year or ten.

The smiths forged bronze tools and weapons and made fine copper and bronze dishes for the tables of the rich. Goldsmiths and silversmiths also made tableware as well as richly wrought jewelry set with turquoise, carnelian, lapis lazuli, and other semiprecious stones. Craftsmen in stone ground out vases jars, bowls, and platters in hard diorite and porphyry, or in soft, cream-colored alabaster, which could be ground so thin it let the light through.

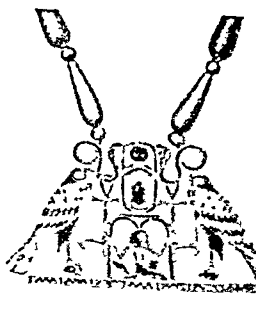
Potters turned clay vessels on a potter's wheel and then baked them in closed clay furnaces as tall as a man. They covered some of the pottery with a blue glaze. Women wove sheer fabrics of linen for clothing and tapestries and awnings for the houses of the rich

Egypt then as now had little timber. Cedar was imported from Lebanon and ebony from Nubia Cabinetmakers made chairs and couches Other craftsmen overlaid the furniture with precious metals or inlaid it with ebony or ivory. The leatherworker contributed cushions. Shipbuilders made Nile vessels with curving hulls and tall sails and cargo ships to sail to foreign lands. Paperworkers took the papyrus reeds gathered from the Nile marshes, split them. and pasted them crosswise into double sheets of pale yellow writing paper (*see* Papyrus Plant).

TABLEWARE AND A NECKLACE



The four small bottles are glass. The larger vessels are pottery and faience.



This is a pectoral (chest ornament) Two horus falcons support a cartouche containing a king's name *Courtesy of the Metropolitan Museum of Art.*

The Gods IN VERY early times each town had its own town god as well as a number of lesser gods. But there were some gods that everybody worshiped. The most important were Re, the sun god; Horus, the sky god; and Osiris, god of the dead.

When a town grew in influence its town-god became more important too. People worshiped him as part of their allegiance to the town. After Thebes became the capital the worship of its god Amun spread throughout Egypt. The people combined his worship with that of the sun, Re, and in this form called him Amun Re. Temples were raised to Amun throughout Egypt. The most splendid was the Temple of Amun at Karnak in Thebes.

A RELIGIOUS PILGRIMAGE AND A GOD

This nobleman and his wife are on their way to the holy city Abydos. The boatman has only to steer the light craft because it is being towed by a rowboat. At the right is the falcon god Horus wearing a very elaborate crown.

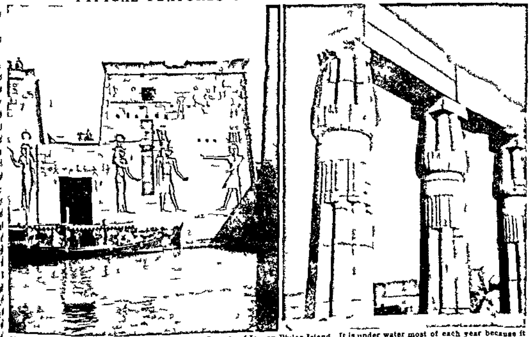
The Story of Re and Osiris

Every day Re, the sun, sailed across the sky in his boat. Every night he disappeared into the underworld in the west. In the underworld was another Nile River. Osiris, ruler of the underworld, had the sun's boat pulled along this river until at last it crossed the horizon and the sun rose again.

Osiris himself had been murdered by his brother Set but lived again in the underworld as king of the dead. The people naturally looked to Osiris to give them also a life after death. Osiris was always shown in human form, tightly swathed in linen like a mummy. (*See also* Osiris; Isis; Mummy.)

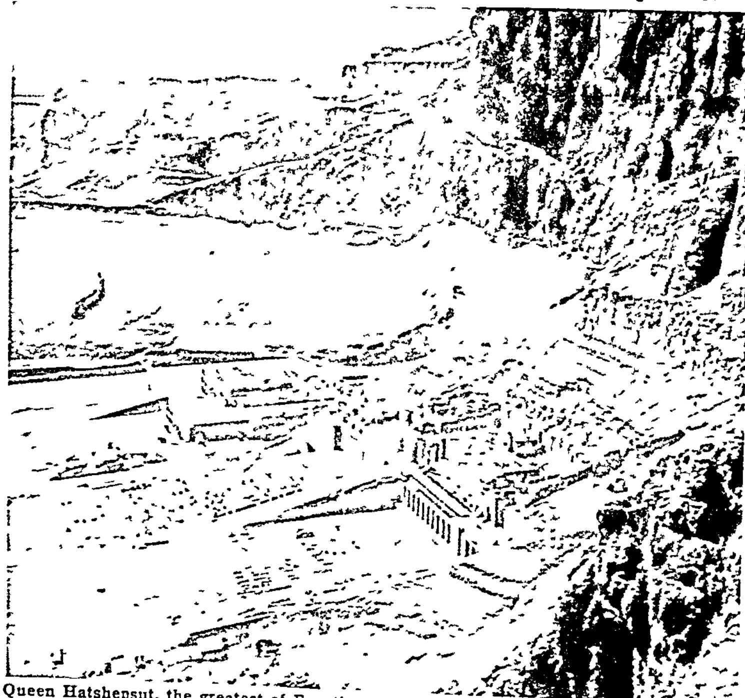
Other important gods were Nut and Hathor, goddesses of the sky; Ptah, master artist and craftsman; Thoth, the moon god, who was also scribe of the gods and inventor of writing; and Khnum, who fashioned men and women on a potter's wheel. Some gods, such as Amun and Osiris, were always represented in purely human form. Others were pictured as animals or with human bodies and animal heads. Thus Horus was worshiped in the form of a hawk (or falcon) or a hawk

TYPICAL FEATURES OF EGYPTIAN ARCHITECTURE



At the left we see part of the gateway (pylon) to the Temple of Isis on Philae Island. It is under water most of each year because it lies in the Aswan Reservoir. The columns (right) represent tied bundles of papyrus stalks, a form much used by Egyptian architects. They stand in the court of the temple in Luxor, south of ancient Thebes.

THE TERRACED TEMPLE OF AN ANCIENT QUEEN



Queen Hatshepsut, the greatest of Egypt's women rulers, built this temple against the sheer stone cliffs at Deir el-Bahri, west of Thebes.

headed man. Thoth was an ibis, Khnum was a ram, and Hathor was a cow. The sun had various symbols —the obelisk, the sacred scarab beetle, the uraeus cobra, and the sun disk.

Certain sacred animals were carefully kept in temples. When Egyptian civilization decayed in very late days, the people came to regard every animal of these species as sacred. They embalmed thousands of crocodiles, cats, and ibises and buried them in special cemeteries. Bulls were buried in splendid stone vaults in an underground cemetery called the *Serapeum*, at Memphis.

Architecture THE NILE Valley is as level as a floor. On both sides it is walled in by limestone cliffs. The Egyptians built to fit the setting. Their temples are gigantic, the surfaces are flat. The form is rectangular, like the flat-topped cliffs. The only decorations are reliefs and inscriptions carved on the flat stone surfaces. These do not break the straight lines of the building. Private tombs were decorated and inscribed in the same way.

Temples were built on a grand scale. The front wall consisted of two massive sloping towers (together called a pylon), with a door between them. The door gave entrance to a huge unroofed court, bordered on two or three sides by colonnades. Here the public assembled for worship. Beyond the court rose the *hypostyle hall*—a forest of huge pillars holding up a roof. Beyond the hall was the sanctuary of the god of the temple. Only priests and the pharaoh could enter here. There were many variations of this simple plan. Large temples—particularly the great temple at Karnak—had a series of courts, each faced by a pylon. An avenue of sphinxes led from Karnak to the temple at Luxor.

Art WALL PAINTINGS took the place of reliefs in many private tombs of the New Kingdom. Some of the paintings and reliefs of this period rank with the world's finest masterpieces of art. In order to appreciate them, it is necessary to understand the principles upon which Egyptian artists worked.

THEY DANCED AS THEY PLAYED

The girls are professional entertainers. From left to right they are playing a harp, a lute, oboes, and a lyre. The three in the center (including the small apprentice) are dancing with slow rhythmic movements.

Like other early peoples, the Egyptians did not use perspective. Figures at different distances from the observer were drawn in the same size. Humble people and servants, however, were pictured smaller than the great lord. Furthermore the artist did not limit himself to a single point of view. He drew what he *knew*, not what he *saw*. He might sketch a fisherman in a boat as if he were looking at the scene from the shore; but he would show fish swimming under the water. The same picture might even show the outline of the pond as if seen from above. Nevertheless Egyptian paintings are beautiful

and harmonious and they tell us more than they would if drawn from a single point of view

In sketching people the artist usually followed certain conventions that were established in early times He wanted to show *all* the principal parts of the body so he combined front and side views The head is always in profile but the eyes are drawn as they appear from the front The shoulders and skirt are front view but the legs and feet are side view

Sculptors carved thousands of statues of gods kings and nobles as well as animals and sphinxes in all sizes from colossal figures to miniatures The pharaoh is always shown in a dignified pose never in movement The face is often an expressive portrait The sculptor painted the bodies of men red and women pale yellow and set in eyeballs of colored stone or crystal

A FAMILY OUTING ON THE NILE

The same nobleman is shown engaged in his two favorite sports—hurling throw sticks at ducks left and spearing fish with a harpoon (right) He is to be thought of as hidden by the tall papyrus reeds Above them he holds two herons as a decoy

Writing THE ANCIENT Egyptians had three different ways of writing They are called *hieroglyphic hieratic* and *demotic* Hieroglyphs were carved on a stone surface with a chisel The word comes from two Greek words *hieros* meaning sacred and *glypho* meaning sculptured Out of hieroglyphs the Egyptians developed a cursive writing called *hieratic* This was written on papyrus with a pen Out of hieratic there developed in the Late Period a much more rapid script known as *demotic*

Hieroglyphic writing developed out of picture writing toward the end of the prehistoric period Until then the only way to record an event had been to draw a picture of it Only the simplest facts could be told in this way Picture recording developed into writing when men realized that pictures of objects could be used to express all kinds of ideas if the words for these ideas had the same sounds as the names of the objects pictured The picture of a house meant house but it could also mean the *sound of the word for* house which was *per* The word for to go also has the sound *per* Hence the sign for *house* could be used to write *to go* by adding to the house sign a pair of walking legs Hieroglyphic writing is therefore mainly sound writing although it uses pictures and most of the pictures stand for syllables rather than single consonants

A SCRIBE

With pen in hand he is ready to take down what his master dictates This famous Scribe of the Old Kingdom is in the Louvre Paris

In hieratic and demotic writing the signs no longer resemble the pictures from which they were developed Rapid cursive writing with a pen on the soft surface of papyrus led to shortening the signs

THE ROSETTA STONE

The stone repeats the same text in three scripts At the left portions of each section are magnified The writing at the top is hieroglyphs in the middle demotic at the bottom Greek

The Rosetta Stone Key to the Hieroglyphs

The ability to read hieroglyphs died out with the Egyptian religion Throughout the Middle Ages people thought the inscriptions on monuments were not writing but symbols with some deep religious meaning

When Napoleon came to Egypt in 1795 he brought with him a large staff of scholars and scientists to study the civilization of ancient Egypt One of his officers discovered near Rosetta a stone inscribed with three kinds of writing Napoleon s scholars recognized the writing as Greek at the bottom demotic in the middle and hieroglyphs at the top They

could read the ancient Greek; and they guessed the other sections must have the same content. The stone fell into the hands of the British, who sent copies to scholars throughout the world. In 1822 Jean François Champollion, a French scholar, deciphered the hieroglyphs. This gave birth to the science of Egyptology.

The Literature of Ancient Egypt

Ancient Egyptian literature consists of both religious and nonreligious texts. The principal religious texts were designed to guide the dead into the beyond. In the Old Kingdom such texts were only for the use of the king. They were written on the walls of his burial chamber in the pyramids and are called 'Pyramid Texts'. Later, 'Coffin Texts' were written on coffins of private citizens. Still later, religious texts, now called 'Book of the Dead', were written on papyrus rolls and buried with the dead.

Nonreligious writings relate events in the lives of kings or citizens. Purely literary compositions include poetry and tales of adventure. (For Reference-Outline and Bibliography, *see* Ancient History.)

EHRLICH, PAUL (1854–1915). "We must learn to shoot microbes with magic bullets," Paul Ehrlich often exclaimed. By "magic bullets" Ehrlich meant chemicals which would kill disease microbes in the body. His most spectacular discovery was the "magic bullet" *salvarsan*, which was long used to treat syphilis. Equally important was his "side chain" theory, dealing with the way the body fights off certain disease poisons. Ehrlich also discovered a way to standardize the manufacture of antidiphtheria serum, and he made important contributions to the knowledge of cancer. In 1908 Ehrlich was the co-winner of the Nobel prize for medicine.

Ehrlich, the son of Jewish innkeepers, was born in Silesia (now a part of Poland) March 14, 1854. At medical school he was a rebellious student, but his instructors recognized his great promise. He received his M.D. degree from the University of Leipzig in 1878 and began to practice medicine. He served as assistant to Robert Koch and then in 1896 he became director of the Institute for Serum Study near Berlin.

One of Ehrlich's first discoveries was a dye that would move through the body and deposit only at nerve endings. This method of *staining* is still important in nerve studies. In 1907 he compounded a dye he called *trypan red*. When injected into mice it destroyed the microbes called trypanosomes.

Trypanosomes are similar to the *Treponema pallidum*, the microbe that causes syphilis. In 1909, after 605 failures, Ehrlich and his assistants found an arsenic compound that acted against syphilis as trypan red did against trypanosomes. They named the compound salvarsan. The following year Ehrlich announced his "side chain" theory of immunity.

Ehrlich was a small, thin-haired man with a furrowed brow and a gray beard. He was nervous and energetic but cool and precise when he worked. He often reminded his assistants, "It is because we are not exact that we fail." Ehrlich died Aug. 20, 1915.

EINSTEIN, ALBERT (1879–1955). Any list of the world's great thinkers will always contain the name of Albert Einstein. His theories established a new concept of the physical world and led to such advances as harnessing atomic energy (*see* Atoms).

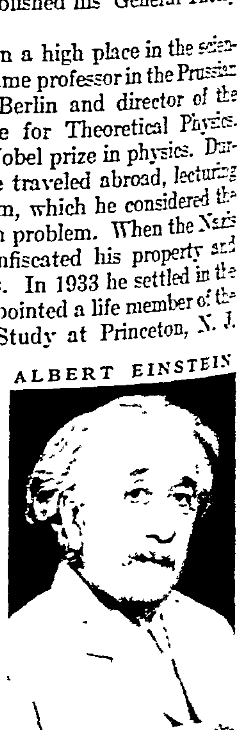
Einstein was born in Ulm, Germany, March 14, 1879, of Jewish parents. His father was a small merchant and manufacturer. Young Albert was shy and dreamy and he kept much to himself. His love of music began when he wrote words and music for little religious songs. All his life he enjoyed playing the violin.

The family moved to Munich, where Einstein went to elementary school. He was only an average student in school, but he taught himself analytical geometry and calculus. When he was 15 the family moved to Milan. Einstein attended high school in Aarau, Switzerland, and the technical college at Zurich. In 1901 he married Mileva Marec. They had two sons but were later divorced. He married his cousin Elsa Einstein in 1917.

In 1902 Einstein became an examiner in the Swiss patent office at Bern. In this position he had time for study. The result was his 'Special Theory of Relativity', published in 1905. It included his revolutionary expression of the relation between mass and energy. The paper brought him his Ph.D. degree at the University of Zurich and later a professorship there. In 1912 he offered theoretical answers to problems in astronomy, based on concepts of relativity. These predictions were later proved by observation. In 1915 he published his 'General Theory of Relativity'.

By this time he had won a high place in the scientific world. In 1914 he became professor in the Prussian Academy of Science in Berlin and director of the Kaiser Wilhelm Institute for Theoretical Physics. In 1921 he received the Nobel prize in physics. During the next few years he traveled abroad, lecturing on physics and on Zionism, which he considered the best solution of the Jewish problem. When the Nazis came to power, they confiscated his property and publicly burned his books. In 1933 he settled in the United States and was appointed a life member of the Institute for Advanced Study at Princeton, N. J. In 1940 he became an American citizen.

ALBERT EINSTEIN



His theories brought revolutionary advances to physics

After 1929 he worked on what was to crown his career, the unified field theory. This theory was to explain all phenomena of the physical universe by one basic set of mathematical equations. His "generalized theory of gravitation," first announced in 1949 and refined in 1952, completed this vast theoretical work (*see* Relativity). He died April 18, 1955.

DWIGHT D. EISENHOWER—
34th PRESIDENT
of the
UNITED STATES

EISENHOWER, DWIGHT DAVID (born 1890) During the second World War Gen Dwight D Eisenhower won a victory in every campaign he directed He commanded the American invasion of North Africa He directed the conquest of Tunisia Sicily and southern Italy He organized the Allied invasion of France and then commanded the victorious drive into Germany In 1951 he assumed the leadership of the unorganized North Atlantic Treaty forces in Europe to build them into a military bulwark against Communism

When Eisenhower entered the political field in 1952 he was equally victorious In July he won the Republican nomination for president after one of the most successful "amateur" campaigns in American political history Then in November he overwhelmingly defeated the Democratic candidate Adlai E Stevenson, to become the 34th president of the United States Eisenhower's victory made him the first Republican president in 20 years

Choosing a Military Career

The president's father, David Eisenhower, was descended from German immigrants who had settled in Pennsylvania during the 1730's In 1878 the family moved to Abilene, Kan The president's mother, Ida Elizabeth (Stover) Eisenhower was born in Virginia She met her husband while both were students at a United Brethren school in Lecompton Kan

During the late 1880's the Eisenhowers moved from Abilene to Denison Tex, where Dwight was born Oct 14, 1890 When he was two years old the family returned to Abilene There with his brothers, Arthur Edgar Roy, Earl and Milton he grew up on the old homestead of his grandfather Jacob Eisenhower In 1947 this boyhood home was dedicated as a national shrine

During his school days young Dwight was usually called "Ike" by his friends The nickname stayed with him throughout his military and political life Ike's favorite school subjects were English history, and geometry In sports he starred in both baseball and football

Ike graduated from Abilene High School in 1909 For the next two years he worked in a creamery to help pay Edgar's expenses at law school In 1911 he took the entrance examination for the United States Military Academy at West Point He ranked second in the tests but obtained the appointment when the top candidate failed to pass the physical examination Ike was graduated from West Point in 1915 and commissioned a second lieutenant of infantry He had ranked 61st in a class of 168 students

His Rise in the Army

Eisenhower was assigned to the 19th Infantry Regiment at Fort Sam Houston Tex In nearby San Antonio he met Mamie Doud of Denver He married her July 1 1916 the day he was promoted to first lieutenant The Eisenhowers reared one son John (born 1923) a West Point graduate and now an officer in the United States Army

Soon after the United States entered the first World War Eisenhower was promoted to captain He served at various Army training posts and in 1918 took command of a tank corps at Camp Colt, Pa At that time the tank was a new weapon of war

Eisenhower received the temporary rank of major and then lieutenant colonel The war ended one day before he was to sail for France In October 1918 he was awarded the Distinguished Service Medal his highest Army decoration Two oak leaf clusters were added to this medal in the second World War In 1947 he also received the Navy Distinguished Service Medal

After the war he was returned to the rank of captain but was soon promoted to major In the years that followed he had assignments in the United States, the Panama Canal Zone, and Europe His administrative abilities earned him an executive post in the War Department from 1929 to 1933 When Gen Douglas MacArthur became military adviser to the Philippines in 1935 Eisenhower was named his assistant Promoted to lieutenant colonel in 1936 he learned to fly and trained Filipino pilots He also

helped establish the Philippine Military Academy and prepared a defense plan for the islands.

First Commands in the Second World War

Eisenhower returned to duty in the United States in 1940. In March 1941 he received the temporary rank of colonel. Three months later he became chief of staff of the Third Army and in September was promoted to brigadier general.

When the United States entered the second World War he was ordered to Washington by Gen. George C. Marshall, Army chief of staff. In March 1942 he was made chief of operations for the general staff and promoted to major general. In June 1942 General Marshall named him commander of American forces in the European theater of operations. The following month he became a lieutenant general entrusted with planning the invasion of North Africa.

In this position he showed great talent for combining officers of different nations into a single team and for giving proper weight to both military and political problems. He commanded the American forces in the invasion of North Africa Nov. 8, 1942, and soon became commander in chief of the whole operation. In February 1943 he was promoted to four-star general. During the year he launched the successful attacks on Tunisia, Sicily, and Italy.

Victory in Europe

In December 1943 Eisenhower was named Supreme Commander, Allied Expeditionary Forces, in charge of the forthcoming invasion of France. His forces landed in Normandy June 6, 1944, in the greatest amphibious operation in history. By autumn, a whirlwind campaign had driven the Nazis back to the German border. The Allies lost ground in December but rallied to drive through the heart of Germany by spring. The Nazis surrendered May 8, 1945 (see World War, Second). Meanwhile Eisenhower had received the highest American military rank, general of the army, on Dec. 20, 1944.

Late in 1945 he returned to Washington, D C to succeed General Marshall as Army chief of staff Here he gave strong support to universal military training and to the United Nations. In 1948 he retired from the Army to become president of Columbia University. The next year Eisenhower obtained leave from this post to preside over the joint chiefs of staff during the unification of the armed forces Later that year his report of the European campaign was published in a best-selling book, 'Crusade in Europe'.

Three generations of Eisenhowers are shown here. At the left are John (the general's son) with his wife, Barbara, and one of their three children. At the right, another child walks with his grandparents, General and Mamie Eisenhower

HIGH LIGHTS IN EISENHOWER'S MILITARY CAREER

Dwight Eisenhower was a West Point cadet in 1915 (top). Thirty years later (bottom) he was a four-star general directing the invasion of Europe; at the right is Gen. Omar Bradley

In 1951 Eisenhower inspects the honor guard of the United States 1st Infantry Division. He was then commander of the North Atlantic Treaty forces and a five-star general

Eisenhower returned to Columbia Univers ty in 49 but took leave again late in 1950 to develop defenses of Western Europe against possible mmunist aggress on During the next 18 months he anized the various armed services of the North At- t c Treaty Organization (NATO) into a unified nbat group This success increased his already high l tary and political standing throughout the free rld (*See also* United States History)

Wins Presidential Nomination

Until 195? Eisenhower had never been in polit cs d there was some uncerta nty as to which party he vored He had refused in 1948 to be drafted by Democrats as their president al nom nee Late in 51 however Senator Henry Cabot Lodge of Massa usetts began a drive to nom nate the general as the publican pres dential cand date On Jan 7 1952 senhower revealed publicly that he had always been Republican and that he would run for president if received a clear cut call to political duty

The first test of his polit cal strength came in New Hampshire pres dent al primary March 11 e general won a resounding victory capturing all of the state s delegates to the Republ can national nvent on In the next two state primaries (Minne- a and Nebraska) E senhower s name was not the ballot but he received an impressive number write-in votes

On April 2 the general took note of his rising l t cal popularity and asked to be released from NATO command by June 1 (*See also* Truman) s request was granted Eisenhower flew home ne 1 and retired from act ve duty with the Army ree days later he opened a vigorous campa gn for e Republican president al nomination

As a polit cal campaigner Eisenhower was an imme- ate success H s express ve face and warm sincerity ntributed much to his effectiveness as a public speaker At the Republican convent on in Chicago Eisenhower won the nomination on the first ballot in a close race w th Senator Robert Taft of Ohio Sen ator R chard Nixon of California was unanimously elected as the nom nee for vice-pres dent

E senhower s able leadersh p and great personal charm united all factions of the Republ can party Thro ighout the campa gn the general lashed out at the trend toward concentrat on of power in Wash ngton D C He also denounced the corrupt pract ces that had been exposed in some circles of government One of the ch ef targets of his attack was the Democrats weak fore gn pol cy especially in the Far East In an effort to find a solution to the stale- mated Korean war the general dramatically promised I shall go to Korea

Elected 34th President

On Nov 4 1952 Dw ght Eisenhower was elected president by a landsl de He rece ved almost 34 million

EISENHOWER S ADMINISTRATION
1953 1957

Tenth Cabinet post added—Department of Health Education and Welfare (1953)

Armistice halts Korean war (1953)

Earl Warren becomes 14th Chief Justice of Supreme Court (1953)

Supreme Court declares racial segregation in public schools to be unconstitutional (1954)

United States joins Southeast Asia Treaty Organization (SEATO) (1954)

Congress assures Pres dent of power to defend Formosa (1955)

PLANNING STRATEGY FOR THE CAMPAIGN

uring the nine weeks of the election campaign Dwight Eisen wer wo ked long and hard to win the support of American ters He e the general and his vice-p es dential running mate R chard Nixon confer with Arthur Summerfield of Michigan, Republican national chairman (extreme left) and Senator Henry Cabot Lodge of Massachusetts (extreme right)

popular votes, which was the greatest number ever given an American candidate for political office. His electoral vote total of 442 came from 39 states, including such traditionally Democratic states as Florida, Texas, and Virginia. Adlai Stevenson had a popular vote of about 27 million and an electoral vote of 89.

The general's sweeping victory helped his party win control of the 83d Congress, although the Republican majority in both houses was small. The Republicans also scored gains in most state and local elections.

Working for World Peace

Four weeks after his election as president, Dwight Eisenhower honored his most colorful campaign promise by making a special trip to Korea. In a closely guarded visit December 2–5 he toured the battlefront and received firsthand reports of the fighting and the possibilities of an honorable peace settlement.

TAKING THE PRESIDENTIAL OATH OF OFFICE

At noon on Jan. 20, 1953, Dwight Eisenhower became the 34th president of the United States The oath of office was administered by Fred Vinson (at left), chief justice of the Supreme Court. Justice Vinson died later that year.

Immediately after taking office January 20, President Eisenhower made clear his intentions to work for world peace. In his inauguration speech he pledged the United States to a ceaseless quest for an honorable peace with no appeasement of aggressors. He then ordered a European fact-finding trip for John Foster Dulles, secretary of state, and Harold Stassen, head of the Foreign Operations Administration (which replaced the Mutual Security Agency). The two men studied the Allied defense efforts and reported back to the President.

Turning his attention to the Far East the President revoked the ban that had prohibited the Chinese Nationalists on Formosa from attacking the Communist-held mainland of China. President Truman had ordered the "neutralization" of Formosa in 1950, pending the "restoration of security in the Pacific."

Problems on the Home Front

In domestic affairs President Eisenhower instituted a "middle of the road" policy aimed at eliminating or reducing many activities previously carried out by the federal government. One of his first acts was to lift the ceiling imposed on wages in 1951. Then price controls were either removed or allowed to expire.

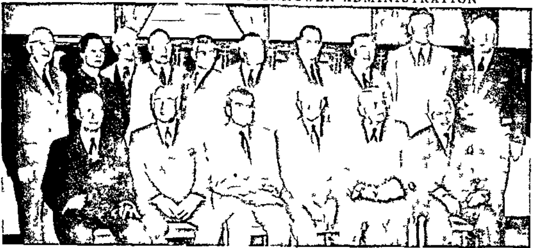
Another major domestic problem was the national budget for the fiscal year 1953–54. The President had inherited a proposed budget of 78½ billion dollars, which was about 10 billion dollars greater than estimated revenue. Despite this projected deficit there was much popular and congressional demand for tax reductions, particularly on incomes and excess profits. To bring the budget near balance Eisenhower helped block some tax cuts in 1953 and ordered federal spending reduced to about 74 billion dollars.

One of the first acts of the 83d Congress was to extend for two years the president's power to reorganize government agencies to secure greater economy and efficiency. Under this act the Chief Executive transformed the Federal Security Agency into the Department of Health, Education, and Welfare, and elevated it to cabinet rank. The Federal Security administrator, Oveta Culp Hobby, was sworn in as the tenth member of the Cabinet, April 11. She thus became the second woman Cabinet member in United States history. The first, Frances Perkins, had served as secretary of labor 1933–45. (For other Cabinet appointments, *see* **Cabinet** in the FACT-INDEX.)

The first sharply partisan issue to confront Congress was the tidelands oil bill—an act to give coastal states title to their offshore areas out to historical state boundaries. (For most states, this is three miles; for Florida and Texas, it is about ten and a half miles.) This question had long been argued with debate generally split along party lines. Most Democrats maintained that these oil-rich lands belonged to the federal government. The administration held that title properly belonged to the coastal states. The value of the oil in these lands was estimated at 50 to 100 billion dollars. In March the House of Representatives passed a bill giving title to the states. Democratic opposition delayed passage in the Senate but the bill was finally approved, and it was signed by President Eisenhower May 22.

The first session of the 83d Congress also extended the Reciprocal Trade Agreements Act for another year (the act was extended again in 1954) and voted to admit an additional 214,000 European refugees into the United States. It authorized the President to send some surplus crops to needy friendly nations. On two occasions Congress rebuffed presidential proposals. It refused to increase the ceiling on the national debt from 275 to 290 billion

TOP LEADERS OF THE EISENHOWER ADMINISTRATION



Among President Eisenhower's original advisors were—left to right seated Attorney General Brownell Secretary of the Treasury Humphrey Vice-President Nixon the President Secretary of State Dulles and Secretary of Defense Wilson standing Budget Director Dodge (resigned 1954) Secretary of Health Education and Welfare Hobby (resigned 1955) Presidential Assistant Adams Secretary of Commerce Weeks Secretary of Interior McKay Postmaster General Summerfield Secretary of Agriculture Benson Secretary of Labor Durkin (resigned 1953) Henry Cabot Lodge Jr and Harold Stassen

dollars and the Senate rejected a House-approved bill to make Hawaii a state

National Defense and the Cold War

Upon taking office President Eisenhower appointed a new military team The civilian secretaries were Charles Erwin Wilson defense Robert Stevens army Robert Anderson (replaced by Charles Thomas in 1954) navy and Harold Talbott air force Named as chairman of the Joint Chiefs of Staff was Adm Arthur Radford The other new chiefs of staff were Gen Matthew Ridgway army Adm Robert Carney navy and Gen Nathan Twining air force

On July 26 1953 the President formally announced the signing of an armistice in Korea He warned however that the United States must remain on guard against the possibilities of other Communist aggressions This warning received added emphasis August 8 when Russian premier Georgi Malenkov revealed that the U S S R had an H bomb

In domestic affairs Secretary of Labor Durkin resigned from the Cabinet September 10 He was replaced by James P Mitchell In another change Governor Earl Warren of California became Chief Justice of the Supreme Court October 5 He succeeded Fred Vinson who died the previous month

Foreign Affairs in 1954

As President Eisenhower began his second year in office the foreign ministers of the Big Four nations met in Berlin to discuss peace treaties for Austria and Germany It was the seventh such meeting since World War II and like the others ended in utter disagreement Three months later Allied and Communist representatives began meeting at Geneva Switzerland Months of negotiation failed to settle the Korean question France however did succeed in obtaining an armistice in Indo-China

The increasing threat of Communist aggression in the Far East led to a meeting of eight nations at Manila On Sept 8 1954 these nations formed the Southeast Asia Treaty Organization (SEATO) for the collective defense of the area Member nations were the United States Australia France Great Britain New Zealand Pakistan the Philippine Islands and Thailand (Siam)

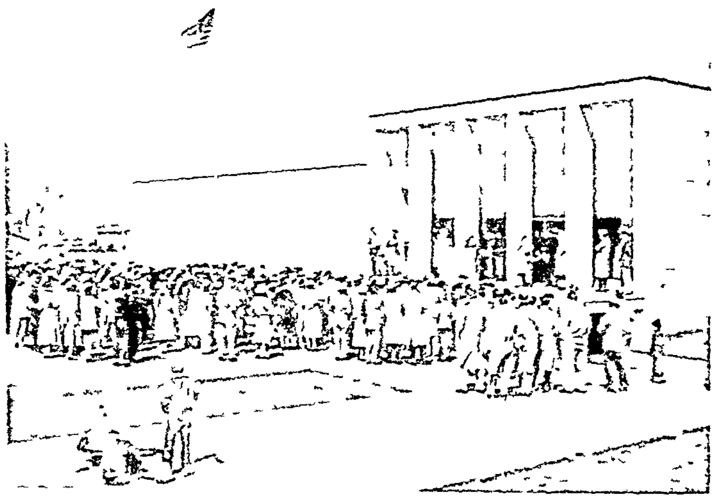
Domestic Affairs in 1954

Early in 1954 an important domestic issue was the proposed Bricker amendment designed to curb presidential powers in foreign relations The proposal was defeated in the Senate February 25 Another center of attention was Republican Senator Joseph McCarthy of Wisconsin chairman of an investigating subcommittee Many people thought McCarthy's tactics (labeled McCarthyism) were a necessary part of his anti Communist investigations Others charged that McCarthy violated democratic principles On Dec 2 1954 the Senate by a vote of 67 to 22 condemned McCarthy on two counts for abusing other senators

The Supreme Court made news May 17 when it ruled unanimously that racial segregation in public schools was unconstitutional This will feed the doctrine of separate-but-equal facilities The verdict affected 17 states with compulsory segregation and 4 in which segregation was permitted

Meanwhile the second session of the 83d Congress reduced excise taxes by about one billion dollars a year effective April 1 This reduction left the administration with an estimated deficit of about 4 billion dollars for the fiscal year and increased pressure to raise the ceiling on the national debt Four months later Congress voted the most comprehensive tax revision in 75 years This measure decreased the national revenue by another 1 3 billion dollars As

EISENHOWER MUSEUM IN BOYHOOD HOME



In 1954 the Eisenhower Foundation Museum was opened at Abilene, Kan. It houses souvenirs and heirlooms of the family.

a result of these reductions in revenue Congress was forced to raise the national debt limit from $275 to $281 billion in 1954 (and again in 1955).

On April 1, 1954, President Eisenhower signed a bill establishing an Air Force Academy, similar to the Army's West Point and the Navy's Annapolis. The site chosen for the new school was near Colorado Springs, Colo. Five weeks later Congress authorized the United States to join with Canada in constructing the St. Lawrence Seaway, a project recommended by every president since Warren Harding.

In other action the 83d Congress outlawed the Communist party in the United States and tightened other security regulations. Despite Democratic opposition Congress also voted to revise the Atomic Energy Act and to provide more flexible supports of farm prices (between $82\frac{1}{2}$ and 90% of parity).

Mid-Term Election

Halfway through President Eisenhower's term the voters of the nation went to the polls to elect a new House of Representatives and one third of the members of the Senate. Late in the campaign the President made a vigorous plea for the election of a Republican Congress. In one day he flew more than 1,500 miles to address crowds in four states.

Despite the President's efforts, the Democrats won control of both houses of Congress in a close election. The Democrats had a net gain of 20 seats in the House of Representatives and 2 seats in the Senate. They also won 8 new governorships to bring their total to 27.

The election results seemed to indicate a dissatisfaction with the Republican party rather than with the President himself. Many political observers believed that only Eisenhower's campaigning prevented an even larger Democratic victory. In addition, a public opinion poll revealed that more than two thirds of all the voters thought the President was doing a good job. The poll showed President Eisenhower to be more popular at the end of two years in office than at the time of his inauguration.

The Nation in 1955

On Jan. 6, 1955, the President gave an optimistic report on the nation in his state of the Union message to the 84th Congress. He pointed to the economic well-being at home and the slight easing of international tensions abroad. As part of his continuing "moderate progressive" program he asked Congress to liberalize the foreign trade policy and to increase the federal minimum wage from 75 to 90 cents. He also asked for a large highway and school building program.

The President estimated that federal spending for the fiscal year 1955–56 would be about $62.4 billion. Almost two thirds of the amount would be for national security purposes—the armed forces, mutual aid to friendly nations, atomic energy development, and stockpiling of strategic materials. This budget would exceed estimated revenues by about $2.4 billion.

One of the first acts of the new Congress was to increase the salaries of Senate and House members and federal judges (*see* table in United States Government). The officers and enlisted men of the armed forces also received a raise in pay. A Democratic proposal to reduce income taxes was defeated. One of the administration's major bills was a three-

ADDRESSING THE 84TH CONGRESS

Standing behind President Eisenhower are Vice-President Richard Nixon (left) and Speaker of the House Sam Rayburn.

year continuation of the reciprocal trade agreements law. This measure would give the president authority to negotiate agreements with other nations to cut tariffs by 5 per cent in each year. After rejecting a number of crippling amendments, the bill was passed by Congress in June.

Early in 1955 two important appointments by the President became effective. On March 16 the Senate confirmed the nomination of Judge John Marshall Harlan of New York to the Supreme Court. He replaced Justice Jackson, who had died the year before. Then on March 19 Harold Stassen was named to the newly created post of special assistant to the President for disarmament. The position was to have the rank of a Cabinet officer. Stassen had formerly headed the Foreign Operations Administration, which expired June 30. Other 1955 appointments were Wilber M. Brucker to succeed Robert Stevens as secretary of the army and Marion B. Folsom to replace Oveta Hobby as secretary of health, education, and welfare.

The President also made two changes in the Joint Chiefs of Staff. General Maxwell Taylor replaced General Ridgway as army chief of staff and Rear Adm. Arleigh Burke succeeded Admiral Carney as chief of naval operations. Both Admiral Radford and General Twining were reappointed to two-year terms.

One of the most important developments in medical history came April 12, 1955, when an antipoliomyelitis vaccine was pronounced a success. The vaccine was discovered by Dr. Jonas E. Salk of Pittsburgh (*see* Vaccines). On May 4 President Eisenhower pledged that no child would go without the polio vaccine because his parents could not pay for it.

On May 31 the Supreme Court gave its long-awaited ruling on eliminating racial segregation in the public schools. The Court voted unanimously that segregation problems should be handled by United States district courts and by local school authorities.

The Cold War in 1955

A grave problem that faced the President in 1955 was the continued aggressiveness of Communist China. In January Congress passed a joint resolution assuring President Eisenhower of his power to use United States military forces in the defense of Formosa and the Pescadores Islands. The following month the 7th Fleet protected the evacuation of the Tachen Islands by the Nationalist Chinese.

In Europe also Communism posed a constant threat to the free nations. To bolster their strength the Western powers ratified the Paris Agreements of 1954. This decision permitted West Germany to rearm and to become a sovereign nation May 5, 1955. The new nation was admitted to the Western European Union and to the North Atlantic Treaty Organization. On May 15 Austria regained its independence as a result of an agreement between Russia and the West. The problem of dealing with West Germany and Austria had been a source of international tension since soon after the end of World War II.

Another proposal to ease the cold war was a meeting of the heads of the big four powers—the United States, Great Britain, France, and Russia. The last such meeting had been at Potsdam, Germany, in 1945. Finally in the spring of 1955 the way was cleared for a "top level" conference in Geneva, Switzerland, beginning July 18.

PRESIDENTIAL HONORS AND FARM RETREAT

President Eisenhower receives an honorary doctor of law degree from Gen. Mark W. Clark of The Citadel at Charleston, S. C.

The President likes to take short vacations at his farm near Gettysburg, Pa. This home became his voting residence in 1955.

ELBE (*ĕl′bē*) **RIVER.** After the Rhine, the Elbe is Germany's most important river. It is 725 miles long, with about 525 miles navigable for large ships. Its drainage basin, about the size of Illinois, covers 56,000 square miles. In this basin lie Germany's chief sugar-beet fields and many grain farms, pasture lands, forests, mines, and factories. The river's cargoes of coal, lumber, salt, fertilizers (potash), sugar, wheat, rye, cattle food, paper, glass, and machinery total millions of tons each year.

The Elbe rises on the southern side of the Riesen Gebirge (Giant Mountains) in Bohemia. It curves west and north and then breaks through the Erz Gebirge (Ore Mountains) into Saxony. Thence the river continues northwest across the German plain. At Hamburg it flows into the North Sea through a broad fan-shaped mouth, or estuary, 75 miles long.

Navigation for large boats begins at Melnik in Bohemia. The chief ports downstream include Aussig, Dresden, Riesa, Wallwitzhaven (port for the city of Dessau), Schönebeck, Magdeburg, Hamburg (continental Europe's greatest seaport), and Cuxhaven.

A large volume of freight enters the Elbe from its three tributaries, the Moldau (Vultava), the Saale, and the Havel. At Magdeburg, the Mittelland-Kanal (Midland Canal) connects the Elbe with the Rhine, the Ems, and the Weser, to the west; and with the Oder, to the east. The Elbe-Trave Canal leads to the Baltic port of Lübeck, and the Kiel Canal links the river to Kiel, Germany's former naval port on the Baltic Sea.

ELDER. The white blossoms of the shrubby elder plant adorn many a country lane in June. Later come clusters of dark-red, purple, or black berries. In older days housewives made them into elderberry wine. Of the 20 or more species of the elder, five are native to the United States. They range from Nova Scotia to the Gulf of Mexico and westward some 2,000 miles. Most common is the American elder. It grows profusely in rich, moist soil throughout the Eastern states.

Scientific name of American elder, *Sambucus canadensis.* Flowers growing in flat-topped clusters at ends of branches; tiny calyx and corolla of 5 spreading lobes; 5 stamens; 3-parted style. Stem smooth, pithy, from 4 to 10 feet high. Leaves opposite, pinnately compound.

ELECTIONS. The basic principle of democracy holds that the people govern themselves. In most cases they govern indirectly. That is, they elect officials to represent them. This is done in class elections, club elections, and political elections.

In the United States, political elections are of two types—primary and general. Most states hold primary elections to nominate candidates for office from each political party. The successful candidates then run in the general election in which voters actually select local, state, and national officials. One exception is the practice of *cross-filing,* first used in California. This allows a candidate to file for office on the primary ballots of all political parties. If victorious in each party he is then automatically elected to office (*see* Primary Elections).

To take part in elections a voter must meet the qualifications established by his state (*see* Suffrage). The voter casts a secret ballot, either by writing or by using a voting machine (*see* Ballot). In addition to voting for public officials he may also vote upon measures submitted to the people for decision. The votes are counted by election officials. These persons are sworn in and their expenses are paid by the local government.

How Some Candidates Are Elected

In most elections a candidate needs only a *plurality* of votes. For example, if Jones receives 100 votes, Smith 80, and Brown 60, Jones has a plurality of 20 votes over Smith, and so he would be elected. In some elections, however, a candidate needs a *majority* of all the votes cast. Thus in the above example Jones would not be elected. He would have to receive more than half of the 240 votes cast, or at least 121 votes, to be elected. When no one receives the necessary amount, a "run-off" election is usually held between the two highest candidates.

Some elections are designed so that a minority party receives proportional representation. For example, in Illinois three representatives to the General Assembly are elected from each district. The voter has three votes. He may give one vote apiece to three candidates, or one and one-half votes to each of two, or he may give all three votes to one. If a minority party concentrates its votes on one candidate, it can elect one representative from each district. (*See also* Municipal Government.)

Electing the United States President

The Constitution provides that the president shall be elected by an *electoral college.* This is a group of electors chosen in each state; and the original intention was that the electors should vote for any candidate they chose. (For changes made in constitutional procedure, *see* President; *see also* United States Constitution.)

Custom, however, has altered the earlier practice of electing a president. Today each major political party nominates a candidate (*see* Political Parties). Each of these parties also has its own slate of presidential electors in each state. They are named by a party convention in the state or in a primary election. These electors are pledged to vote for their party's candidate if they win in the general election in their state.

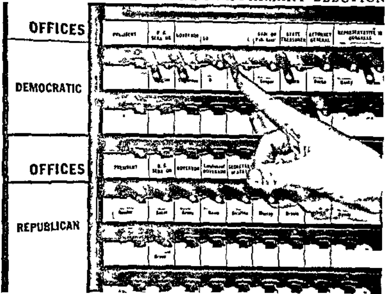
The general election of presidential electors takes place every four years on the Tuesday which follows the first Monday in November. States vary in their presentation of names on the ballot. Some list by party only the names of electors. Others present both the names of presidential candidates and the electors. About half the states give only the names of the candidates. In all cases the voters name only the slate of electors of the indicated party. But in actual effect the voter is casting his ballot directly for one presidential candidate.

In each state the party that receives the most votes for its electors receives the entire electoral

vote of that state Votes cast for defeated candidates do not count in any way The successful slates of electors meet in their respective state capitals on the Monday which follows the second Wednesday in December There they cast their votes for president and vice-president The candidates are formally elected when Congress counts the electoral votes from each state

Once the general election is over, however, the remaining steps are only formalities As soon as the states count their votes for the presidential electors the name of the next president is known Each elector has the constitutional right to vote for anyone he chooses But only twice in history has an elector failed to carry out the wish of the majority of the voters in his state In 1820 an *elector* voted against James Monroe because he wanted Washington to remain the only president elected unanimously And in 1948 a Tennessee elector voted for Thurmond even though Truman had carried his state

USING A VOTING MACHINE IN A PRIMARY ELECTION



Under each office are the names of the candidates for nomination in a primary election The voter presses down the small *voting lever over the name of each candidate for whom he wishes to vote* Then he pulls a large lever which registers his choices and restores the voting levers to their original positions

Complications Caused by the Electoral System

If no presidential candidate receives a majority in the electoral college the 12th Amendment to the Constitution provides that the election should be decided by Congress The House of Representatives chooses the president by ballot from the three candidates with the highest electoral college totals Each state has one vote, and a majority of votes is necessary to election The Senate chooses the vice-president from the two candidates having the most electoral votes for that office The senators vote as individuals and not by states The House has twice elected a president Thomas Jefferson in 1800 and John Quincy Adams in 1824 The Senate has elected one vice-president Richard M Johnson in 1837

Several elections have turned upon the fact that the winner in a state gets the entire electoral vote *of that state* Three men gained the presidency even though another candidate had a larger popular vote They were John Quincy Adams, Rutherford B Hayes, and Benjamin Harrison Eight other presidents won a *majority* in the electoral college without receiving a majority of the total popular vote These "minority presidents" were Polk, Taylor, Buchanan Lincoln, Garfield, Cleveland Wilson and Truman

From time to time there are proposals for a constitutional amendment to change the present system One plan would be to divide a state's electoral votes in proportion to its popular vote But small states generally favor the present *method* *In a nationwide* popular vote the small states would *count for* little against the huge total of votes cast by the largest states Under the electoral system heavy minority votes in the largest states are in effect canceled out And the majority vote in a few small states might be decisive in a close *election*

Beginning with the presidential election of 1952 the electoral votes of each state were as follows

Alabama	11	Maine	5	Ohio	25
Arizona	4	Maryland	9	Oklahoma	8
Arkansas	8	Massachusetts	16	Oregon	6
California	32	Michigan	20	Pennsylvania	32
Colorado	6	Minnesota	11	Rhode Island	4
Connecticut	8	Mississippi	8	South Carolina	8
Delaware	3	Missouri	13	South Dakota	4
Florida	10	Montana	4	Tennessee	11
Georgia	12	Nebraska	6	Texas	24
Idaho	4	Nevada	3	Utah	4
Illinois	27	New Hampshire	4	Vermont	3
Indiana	13	New Jersey	16	Virginia	12
Iowa	10	New Mexico	4	Washington	9
Kansas	8	New York	45	West Virginia	8
Kentucky	10	North Carolina	14	Wisconsin	12
Louisiana	10	North Dakota	4	Wyoming	3
TOTAL					531

(For a table of the presidents *see* **President** in the FACT-INDEX For statistics of presidential elections *see* **United States Government** in the FACT-INDEX)

ELECTRIC GENERATOR AND MOTOR The transformation which electricity has brought about in civilization could not have taken place without a *method of* turning mechanical power into electrical current. Useful as electric batteries are, they could never supply the vast amount of current needed to light cities run streetcars and drive industrial machinery.

The English physicist Michael Faraday invented the dynamo or electric generator. He discovered that if a wire is moved through the field of a magnet, an electric current is *induced* in the wire. This discovery of electromagnetic induction is the basis of virtually all electric power today.

Faraday's discovery is shown in Fig. 1. Two poles (N and S) of a magnet are arranged so that lines of magnetic force cross from the north to the south pole in a straight path. Across their path a wire, W–E, is moving in the direction of the two arrows, that is, from the front toward the back of the picture. We must imagine that this wire is part of a circuit. So long as it remains in motion across the magnetic field in the direction indicated, a current will flow in the wire in the direction shown by the white arrow C. But if we reverse the motion of the wire, pulling it toward us through the field instead of pushing it away from us, the current flowing in the wire will also be reversed.

AN INDUCED CURRENT

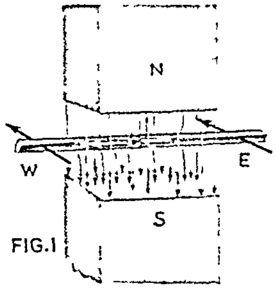


FIG.1

The fact that the movement of wire across a magnetic field induces an electric current in the wire, as shown in this picture, is the foundation principle of the generator.

The quantity of current induced in this wire will depend upon the number of magnetic lines of force it cuts through per second. Two things decide what this number will be. The stronger the magnet, the more lines of force exist in its field; and the faster the wire moves, the more of these it crosses.

The fundamental law of physics that you cannot produce energy without expending energy applies here, of course, as it does in all machines and processes. For the stronger the magnet and the faster you try to move the wire through its field, the more resistance you encounter to that motion. How the current induced in the wire sets up a force that tends to thrust the wire back is explained in the Electricity article.

In this connection a fact should be noted here that will be usefully remembered in connection with many electrical phenomena. It is evident that if the wire W–E were stationary in the magnetic field no current would be induced in it. But if a current from some *outside source* were then passed through it in the direction of the white arrow, this current would set up a conflict of forces that would tend to push the wire out of the field toward the near side. In one case the motion of the wire produces a current and in the other case a current produces a motion of the wire.

Current Induced in Rotating Loop

The next step in the development of an electric generator after Faraday's discovery was to devise a method of moving a wire continuously through a magnetic field so as to provide a steady supply of induced current. The problem was essentially simple, as Fig. 2 indicates. Here we have a loop or *armature* rotating in a field. The direction of rotation in the picture is assumed to be clockwise, so that the upper side A of the loop is just starting down across the magnetic field, while the lower side B is just starting upward. Since the two sides are moving across the magnetic field in opposite directions, the current in each will be opposite. In B it will flow toward the back, in A toward the front of the loop. But, of course, so far as the electrical circuit is concerned, these two currents are in the same direction, the one through B passing up and around the back end of the loop so that when it reaches the side A it is moving in the same direction as the current induced there.

It is evident that if the loop were a continuous unbroken ring, current would flow around it uselessly. To allow the current to be collected, the ends of the loop are formed into half cylinders with a gap between them. From these half cylinders, which form what is called a *commutator*, the current passes by sliding contact to the *brushes* C and D.

Current in Loop is Alternating

The purpose of the commutator is not only to collect the current from the loop, but also to keep it flowing always in the same direction. The need for this is obvious. For the current in the loop itself reverses its direction twice in each rotation. Consider the side A of the loop, for example. The current moves through it in the direction indicated by the arrows only when it is passing *downward* through the field. When it reaches the bottom of its swing, crossing the vertical plane between the poles of the magnet, and starts *upward* through the field, the current in it will, of course, take the direction now shown in the side B. If it were still connected to the brush C, the current through that brush, and hence through the entire circuit, would be reversed. But just as it passes the vertical plane, A's half of the split commutator slides out of contact with brush C and into contact with brush D. At the same instant, of course, B's half of the commutator breaks connection with D and makes contact with C. Thus the contact in the outer circuit

ESSENTIAL MECHANICS OF A GENERATOR

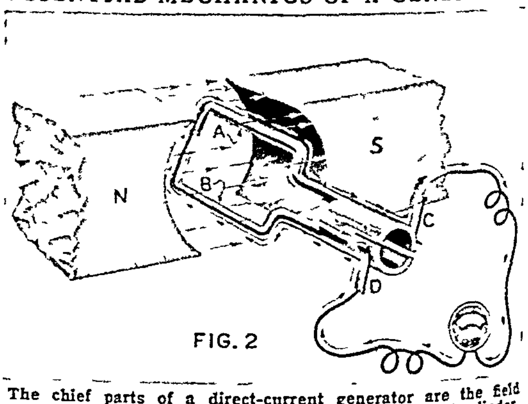


FIG. 2

The chief parts of a direct-current generator are the field magnets (N and S), the armature (AB), and the split cylinder, called the commutator, from which the brushes (D and C) collect the current. Light arrows show the direction of the magnetic lines of force; black arrows the direction of the current through the outer circuit, containing an ammeter.

SIMPLE GENERATORS FOR ALTERNATING AND DIRECT CURRENT

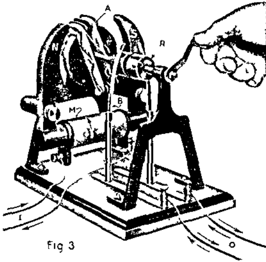


Fig 3

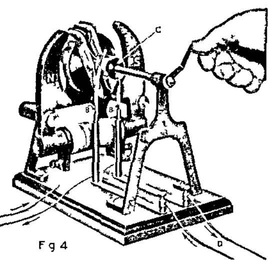


Fig 4

The magnetic field in Fig 3 is produced by an electromagnet The current for this magnet enters and leaves through wires I Its direction around the coil M is such as to make the left side of the pole piece N the north pole and the other side the south pole Instead of the commutator shown in Fig 2 and in Fig 4 it has two slip rings R) connected to the two ends of the coil of wire wound around the armature (A Thus the alternating current induced in the turns of that coil by the rotation of the armature reaches the outer circuit without interruption through the brushes B The current changes direction each time the armature coil reaches a vertical position that is twice in each rotation Two alternations constitute a cycle In Fig 4 everything is the same as in Fig 3 except for the commutator (C and the position of the two brushes (B and B_1)

continues always to flow in the direction shown by the arrows The current obtained in this manner is called a *direct current* (abbreviated D C) For many purposes as we shall see it is neither necessary nor desirable to turn the output of a generator into direct current The *alternating current* (A C) naturally produced by the generator is permitted to flow back and forth in the outer circuit

Armatures and Magnetic Fields

The single loop used for the sake of clearness as the armature in Fig 2 would produce only feeble currents even if revolved at great speed The armatures of practical generators consist of many turns of insulated wire wound around iron cores The induced current is proportional to the number of turns since each turn forms a loop in which a certain amount of current is generated more or less independently of the other turns The iron core concentrates and increases the lines of force that pass across the armature

In certain small generators called *magnetos* the magnetic fields are produced by permanent magnets For generating large currents however stronger fields are needed and these are obtained by using electromagnets The construction of simple laboratory generators embodying iron core armatures and fields produced by electromagnets is shown in Figs 3 and 4 Both pictures should be examined carefully Fig 3 illustrates the principle of an alternating-current generator or alternator In Fig 4 we see the commutator act on that yields a direct current The current that excites the field magnets of A C generators is derived from an independent source of electricity Direct current generators however usually derive this field current from their own output

The Electric Motor

Suppose that instead of turning the handle of the generator in Fig 4 and taking a current *out of* it through the wires D we feed a current from some independent source through those wires *into* the machine in the direction indicated by the arrows With the armature in the position shown the left side of its core will become the north pole of an electro magnet (The rule for the polarity of electromagnets is explained on page 304 of this volume)

At once we see that this north pole of the armature will be repelled by the north pole of the field magnet while the south pole created at the other side of the armature will likewise be repelled by the south pole of the field magnet For we know that *like* poles of magnets always repel each other The force of this repulsion will *set the armature in motion* It will start revolving Of course the repulsion between like poles is supplemented by the attraction between *unlike* poles and the armature will keep revolving in an effort to bring its north pole in line with the south pole of the field magnet and its south pole in line with the north pole of the field magnet

But just as this line-up is reached the action of the commutator reverses the current in the armature windings What had just been the north pole of the armature suddenly becomes the south pole and vice versa Its momentum carries it past this dead center and the reversed forces of attraction and repulsion send it on around to its former position,

where the commutator again reverses the current, and so on indefinitely. Our generator has turned into an *electric motor.*

The alternating-current generator shown in Fig. 3 can also be run as an alternating-current motor, provided it is set going by hand until its revolutions per second equal the cycles of the alternating current that is being fed into it.

Commercial Generators and Motors

Direct-current generators with only two poles produce currents of fluctuating strength, since at the top and bottom of their rotation the wires of the armature are not crossing magnetic lines of force. On the other hand, bipolar A.C. generators would have to be revolved at tremendous speeds to produce the 60 cycles per second required to avoid flicker in electric lights. For these and other reasons, commercial generators are usually made with four, six, eight, or even more poles as field magnets. These are arranged radially like the spokes of a wheel. Similarly armatures are wound with a large number of separate coils spaced evenly around the core. For D.C. generators, each of these coils has a separate connection to a pair of segments on the commutator (Fig. 5). The armatures of A.C. generators often carry two or three coils for each field magnet. These extra coils are connected so as to form a second or a third extra induction circuit and the generator then produces in effect two or three separate alternating currents, each "lagging" behind the other. Such generators are called respectively *two-phase* and *three-phase* alternators. The currents they produce are carried on three wires, the circuits consisting of wires 1 and 2 for the first phase, wires 2 and 3 for the second phase, and wires 1 and 3 when there is a third phase to be carried.

CONSTRUCTION OF STANDARD ARMATURE

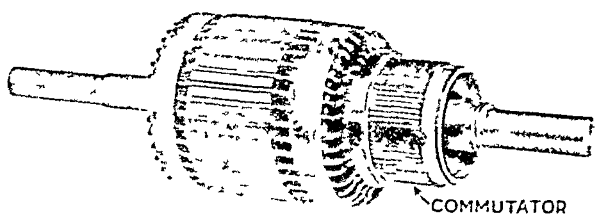


Fig. 5 This is the rotating part of an electric motor. Numerous coils are wound lengthwise around the grooves in the core. Each coil is connected to two of the many segments that form the commutator. This type of armature is said to be "drum-wound."

The Induction Motor

Phase circuits are used to run *induction* motors, the most generally useful of all types. The field coils of a two-phase induction motor are divided into two separately connected sets spaced at alternate intervals around the field. It is evident that, as the two currents, one lagging behind the other, pass through the two sets of coils, the polarities of the field magnets reverse in rotation, producing what are called *rotating magnetic fields.* The armature, or *rotor,* of such a motor does not, therefore, require outside electrical connection to activate it. It usually consists merely of bars of copper set into copper end plates forming a "squirrel cage." The rotating fields induce heavy currents in these bars. But, as we saw earlier in this article, a magnetic field resists the motion of a conductor through it. In this case, it is the field that moves across the conductor, but the effect is relatively the same. The result is that the rotating fields, opposing the motion of the copper bars through them, drag those bars around with them.

Suitably designed induction motors will run on single-phase circuits, once they get up to standard speed, so that the bars of the rotor can keep in step with the alternations of polarity in the field magnets. Such motors usually are started by means of commutators and auxiliary windings on the armature similar to those of the older type of motor; then, as the armature gathers speed, the auxiliary devices are disconnected automatically by a centrifugal switch. The common household motors are of this type.

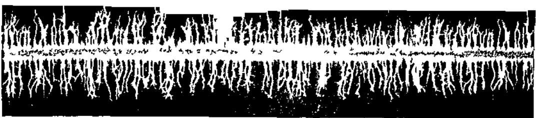
Simplest of induction motors is the one that runs an electric clock. The armature consists only of a metal plate with short projecting arms. Currents are induced in these arms by the alternations of the field magnet. Once started, the armature revolves at a fixed rate (*see* Watches and Clocks).

Losses of power in electric motors are due largely to *eddy currents* set up by induction in the solid metallic parts of the machines, particularly the core of the armature. An eddy current, as its name indicates, is a sort of electrical whirlpool formed when a current revolves around through paths of low resistance inside a piece of metal. To minimize them cores of motors and of transformers (*see* Transformer) are usually made of thin sheets of iron lying side by side but insulated from one another. A useful application of eddy currents is found in electric meters, where an aluminum disk revolves in the field of a permanent magnet. The eddy currents induced in the disk tend, according to our earlier rule of opposition, to check or "damp" the speed of revolution. Eddy currents are responsible also for the action of a speedometer. (*See* Meters; Speedometer.)

How an Electric Bell Works

The electric bell is in substance a type of electric motor. It consists usually of a pair of coils forming an electromagnet and of an armature consisting of a flat piece of iron fastened to a spring arm which holds it close to the poles of the magnet. The clapper in turn is fastened to this armature. One of the connections to the instrument is through a point of metal in contact with the spring arm, which is in turn connected to the coils of the magnet. When the bell button is pressed, closing the circuit, the magnet draws down the armature; but this immediately breaks the connection between the spring arm and the contact point, so the armature springs back, only to be drawn down again by the renewed contact at the spring arm. This produces a continuous and rapid vibration of the clapper against the bell as long as the button is pressed.

The "FIRE OF HEAVEN," *Man's* FRIEND *and* FOE



Have you ever seen an electric current? It is safe to say, you have not but the photographic plate can "see" it when the current is of the high tension' type That is, it can register the almost invisible leaks from a highly charged wire, as this picture shows

ELECTRICITY It used to be the custom to say that electricity was something very mysterious The common remark was "We know some of the things electricity *does*, but no one knows what it *is* " There are those who still talk and write about it in that way, giving the subject a reputation for difficulty which it no longer deserves

Of course, there are still many things we do not know about electricity, and there are numerous electrical theories and technical principles that cannot be understood completely without special training in physics and mathematics But nearly all the most important the most interesting, and the most practical facts about electricity are simple With the aid of a few experiments, let us see if we cannot start with a fairly clear idea of what electricity is

A Few Simple Experiments

If you stroke a cat s back in dry cool weather, you feel little electric sparks under your hand If you shuffle your feet over a carpet and touch another person or some metal object, a small spark jumps from your finger If you rub a glass rod with a piece of silk, or rub with a woolen cloth a rod of hard rubber or similar substance (a stick of sealing wax or the barrel of a fountain pen will do), you can pick up with them little bits of paper or straw or pieces of thread

The results of these first experiments are plainly seen For the next ones, you will require a sensitive galvanometer to detect the electrical effects You can find such an instrument in any school laboratory and check your own results, or you can simply take the word of science that they actually do take place These results are illustrated on the next page, without showing a galvanometer, but the following descriptions tell how to connect the instrument, if you have one at hand

The simplest of the experiments is done with an ordinary horseshoe magnet Fasten a loop of wire to the galvanometer and then pass the loop between the poles of the magnet The needle of the galvanometer moves showing that a current is generated

Now solder the end of an iron wire to the end of a copper wire, connect the other ends of the wires to the galvanometer, and then heat the soldered joint Again the galvanometer indicates a current

Connect with wires to the galvanometer a plate of copper and a plate of zinc Dip the two into a weak solution of sulphuric acid Once more, the needle of the instrument will show that a current is flowing

What do these experiments suggest to you? You have seen electrical effects produced by friction, by magnetism, by heat, and by chemical reaction All sorts of materials from cat's fur to corrosive acid have yielded electricity *If* you had the apparatus you could prove to yourself that electricity can be drawn from the surface of a metal by a beam of light And you know from common observation that it seems to be made out of thin air" by the forces that set up thunderstorms

Moving Electrons "Make" Electricity

Learning these facts for the first time, you might say that almost *everything seems to contain* electricity and that the electricity appears to be there quietly until something comes along to stir it up and move it around This would be very near the truth It was what scientists believed for a long time The difficulty lies in that word ' contain " *No one could explain exactly* what it meant Did matter contain electricity, as a sponge contains water? Then electricity must itself be a separate kind of fluid matter. But this amounted to inventing a bigger mystery than the *one already* in hand

Finally scientists hit upon *an explanation that fitted* the facts so well and proved so fruitful in uncovering new

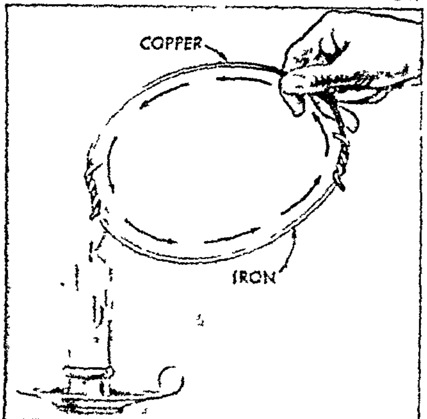
THE OLDEST ELECTRICAL EXPERIMENT

This shows how a piece of amber rubbed on fur will attract bits of paper The ancient Greeks observed this fact using pieces of straw for of course, they had no paper Neither did they have the idea of electricity to explain what happened But when William Gilbert in the 16th century started to study the mysterious force he named it from elektron, the Greek word for amber

facts that it has been universally adopted. Electricity, they said, is not *in* matter; it is a *part of* all matter. It consists of tiny particles called *electrons*, incorporated in the structure of every atom of every element of which the universe is made. The fundamental nature of electrons, in so far as science has formulated theories about them, is discussed elsewhere (*see* Atoms; Electrons and Electronics.) Here we are concerned only with their behavior.

Under neutral conditions, these electrons remain attached to their respective atoms—held there by the attraction of the *protons* which form the center or nucleus of every atom. But when disturbed by energy from some outside source, some of the electrons may leave and wander to other atoms. This migration of electrons is what we call an electric current. Some atoms, like those of metals, for example, transmit electrons freely, and we say they are good *conductors* of electricity; others oppose the passage of the wanderers, and we speak of them as *non-conductors* or *insulators.*

HEAT MAKES ELECTRIC CURRENT FLOW



This simple experiment will prove that heat can cause electric current. Each end of a copper wire is twisted to the ends of an iron wire, making a circle or circuit. If one of the junctions is held in the flame of a candle, a sensitive galvanometer will show current flowing. The action is explained farther on in the article.

Now any atom that has lost a part of its electron quota is in an unbalanced state; it will recover the electrons it lacks from any available source. Similarly, an atom that has acquired more electrons than it needs for its perfect balance will discharge them at the first opportunity. An atom with less than its quota of electrons is said to have a *positive charge* and one with a surplus of electrons is said to have a *negative charge.*

An electric *circuit* is simply a path composed of atoms of sufficiently good conducting properties so that electrons, torn loose at one point by the application of outside energy (friction, magnetism, heat, or chemical action), can travel around and return to fill the places left vacant (positive) by their departure. It is hard to say whether the electrons that start the journey go all the way to the finish, or whether they merely bump electrons off the atoms ahead of them and so pass on the motion, as in a relay race. Since the result would be the same in either case, it is simpler to describe their movement as a continuous passage. If there is no connected path over which this passage can take place; or if the intervening atoms strongly impede their movement, the electrons accumulate at points as close as possible to where they would like to go and form what is called a *static charge.*

What Positive and Negative Mean

Before going further, strong emphasis must be put upon the fact that the terms *negative* and *positive* as used in electrical science are purely relative terms. A body containing excess electrons is negative not only in respect to a body that has too few electrons, but it is negative as well toward a neutral body, and indeed, is negative also toward a body which has *fewer* excess electrons than itself. Similarly, if both bodies have a deficiency of electrons, the one with the *least* deficiency is negative with respect to the other. Of course, all these relations can be described equally well in terms of positive differences.

Difference of Potential

To sum up in concrete terms, whenever they can find a path electrons will flow *from* any spot where they are relatively numerous (negative) *toward* any spot where they are relatively scarce (positive). To understand this relativity of negative and positive is of fundamental importance, because the *force* that impels electric currents to move from one place to another depends entirely upon the *difference* in the concentration of electrons in the two places, or *potential difference,* as it is technically called.

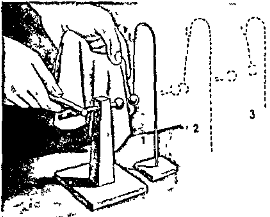
When you shuffle your feet over a carpet, you rub off, as it were, some of the electrons from the atoms that compose the carpet and these accumulate in your body. You become negatively charged to such a degree that the electrons will jump from your finger in a spark when you bring it close to some neutral object.

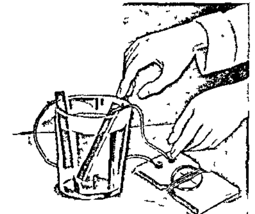
Why does the friction loosen the electrons from the carpet's atoms instead of those from the soles of your shoes? In fact, it loosens both, but far more from the carpet's fibers than from the shoe leather. Substances vary greatly in the way they grip their electrons.

Attraction and Repulsion of Charges

When you rub a hard rubber rod with a woolen cloth, the cloth gives up electrons to the rod. These accumulate on the rod because it is such a poor conductor that they cannot easily run through it into your hand. But, unable to move about freely themselves, they exert their force just the same, the attraction between them and the neutral atoms in a bit of paper being sufficient to move the whole paper toward the rod. This illustrates what is meant by the saying that "unlike electric charges attract each other." In this case, according to the relative meaning of positive and negative which was explained above, the neutral charge in the paper is considered "positive" and therefore "unlike" the charge in the rubber rod. Proof of this relative nature of charges is easy. If instead of rubbing hard rubber with wool, you rub a glass rod with silk, electrons flow out of the glass and into the silk, leaving the rod *positively* charged. Yet it will pick up bits of neutral paper just as well as

THREE WAYS TO MAKE ELECTRICITY

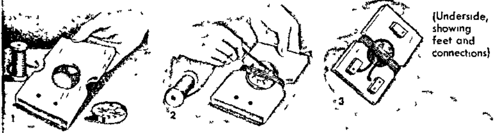




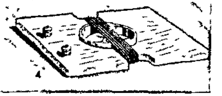
1 FRICTION To make electricity by friction, rub a glass rod with silk This charges the rod, and the existence of the charge can be proved as shown here Rub the glass rod over a metal collecting rod mounted as shown Now bring a suspended pith ball near the end of the collecting rod (1) It will first be attracted into contact (2) and gain a charge Then it will be pushed away (3) since its charge will now be the same (positive) as the charge on the metal rod

2 CHEMICAL ACTION To make electricity by chemical means, connect a piece of zinc through a wire to one binding post of a galvanometer (*see below*) and connect a piece of copper to the other binding post Now put the two pieces of metal into a glass of water and add a tablespoonful of dilute sulphuric acid The galvanometer needle will move, showing that a current is being generated (Do not pour the water upon the acid, put the water in the glass first)

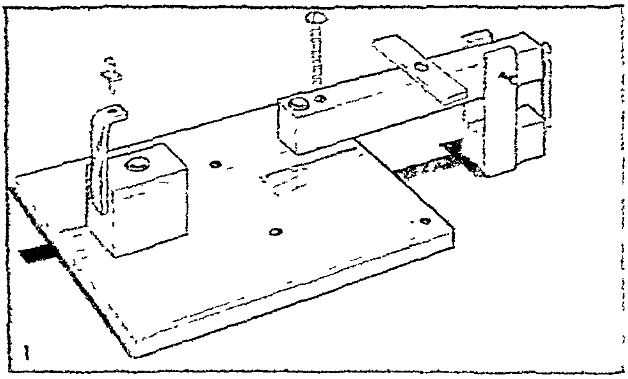
3 MAGNETISM To make an electric current by magnetic action wind about 200 turns of insulated wire into a coil and connect the ends of the coil to a galvanometer Thrust one arm of a strong horseshoe magnet through the coil as shown The galvanometer needle will move showing that electric current has been generated



4 GALVANOMETER A galvanometer for detecting electric currents is useful in many ways The one shown here is easy to make and will amply repay the effort 1 Carve out a hole in a block of wood to hold a compass and notch the wood at each side 2 Set the compass in the hole and wind at least 50 turns of insulated wire tightly around the compass and block. 3 Attach feet ' of felt or wood to the underside of the block and connect the wires to binding posts at one end 4 To use the galvanometer, place it with the compass needle parallel to the turns of the coil Even a slight current through the binding posts will move the needle



HOW TO MAKE A TELEGRAPH SET



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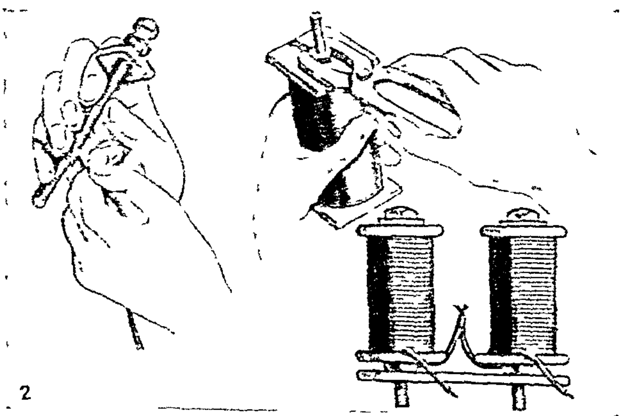

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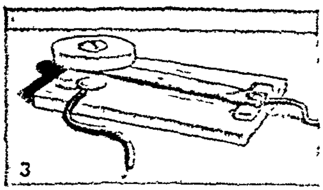

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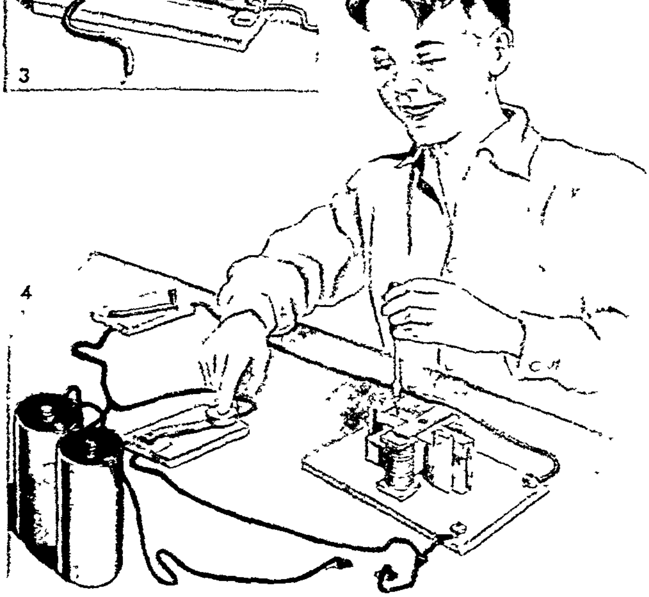


4

DESIGN

The telegraph set shown here is a simplified version, made largely of wood, of the standard equipment which is illustrated and explained in the article on Telegraph. By examining the pictures and explanations in that article, the operation of this set will be made clear. A good size for the set is about twice that shown in the pictures. This device is a practical application of the magnetic action of an electric current when it passes through a coil.

1. SOUNDER

Above (left) are all the parts of the sounder except the electromagnets. The sounder lever and bracket are shown assembled with a thin nail for a pivot and small coiled spring at the back. Two machine screws provide stops for adjusting play. One is let through the lever, and the other is placed on the stop strap at the left. Each strikes on the head of a thumbtack. The only metal work needed is cutting and drilling a short piece of soft strap iron for the armature, and cutting, drilling, and bending the stop strap for the stop at the left.

2. ELECTROMAGNETS

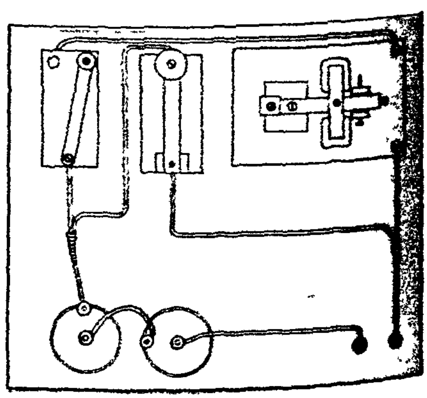
Each electromagnet is wound on an iron bolt, with about 100 turns of common bell wire. The coils should be held between cardboard washers. To give them opposite polarity, magnets should be wound in the same direction and connected by joining the wires from *inside* the coils. Finally, the magnets are mounted on a soft iron strap. The lower bolt ends are set in snug holes in the base. The two free wires are connected to binding posts at one end of the base.

3. SENDING KEY

Fasten one end of a strip of thin spring steel to a base and attach a wooden button to the other end. Place a nail or screw in the base beneath the button to serve as contact when the button is pressed down. A single-throw switch, to close a circuit for receiving, completes the equipment.

4. WIRING AND ADJUSTING

The instruments should be connected to two dry cells. Attach wires as shown. The most important adjustment is that of play in the sounder lever, to make it respond instantly to incoming current. This is done, as shown (left), by moving the two adjusting screws (stops) until the lever gives satisfactory clicks. Below is a diagram of the complete installation.



the rubber rod did with its negative charge. In this case the neutral paper is relatively negative.

The fact that bodies with like charges repel each other even though one charge is very weak and the other very strong would seem at first to be a contradiction of what was said about the tendency of electrons to flow from a place of higher concentration to a place of lower concentration. But this contradiction is only apparent. Electrons dislike one another's unmixed company and every free electron repels every other free electron to some extent. Those in the weakly charged body do not want any more companions than they already have; neither do those in the strongly charged body. So each group of electrons will repel the other. But if a connection is made between them, those in the more closely crowded body will flow into the less crowded body until there is approximately even distribution. You can compare the situation to two rubber balloons filled with air, one under high pressure, the other under low pressure. If you push them together, each will tend to thrust the other away, resembling the repulsion of the electron charges. But if you connect them with a tube, air will flow from the high pressure balloon to the other until the pressures in the two are equalized.

The Direction of Current

A great deal of confusion will be avoided if we clear up at the outset a conflict in terms about the direction in which electric currents flow. In the early days of electrical science investigators believed that there were two kinds of electricity—the kind generated in a glass rod when rubbed with silk, which was called vitreous electricity, and the kind generated in a rod of rubber sealing wax, amber or similar substance when rubbed with wool, which was called resinous electricity. Benjamin Franklin was the first to propose that they be called respectively positive and negative electricity. From then until the time of the discovery of electrons it was assumed that the direction of flow of an electric current in a conductor was from positive to negative. We know today that the electrons which constitute the current are negative particles in the old sense of the word and that when they flow they necessarily move toward relatively positive areas. But the old assumption has become so firmly imbedded in scientific and engineering parlance that we still say, for instance, that electricity flows from the positive pole of a battery to the negative pole, although the electrons are actually moving in the opposite direction. No harm results from this old convention provided it is understood that in virtually all books and discussions "direction of current," unless otherwise qualified, means from positive to negative. Only when electrons are specifically mentioned is it customary to take account of their opposite movement.

We now have before us the essential facts about the nature of electricity in so far as they are needed to explain the practical phases of its behavior. We can turn our attention to some of the things that happen when streams of electrons are set in motion.

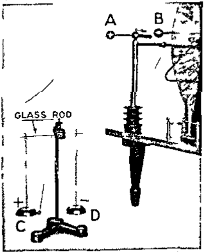
Electrical Resistance

Scientists are not certain why some substances are conductors and others insulators. The theory most widely held is that the difference is probably related to the firmness with which electrons are bound in fixed positions inside the structure of the substance. In metals like copper, for example, the arrangement is believed to be such that some of the electrons belonging to the atom are more or less free to pass on from one atom to another. But even so, as the electrons move from atom to atom in a copper wire they encounter resistance very much like friction, which consumes some of their energy. This resistance varies with temperature, usually decreasing as the temperature lowers, so that at the same potential a cold wire will transmit more electricity than a hot wire.

The term *resistance* is usually applied to a definite circuit or part of a circuit. But when engineers discuss the degree to which various substances oppose the passage of electricity, they employ the terms *specific resistance* or *resistivity*. When the emphasis is to be put upon the ability to conduct current rather than upon the property of opposing it, the terms *conductance* and *conductivity* are used. The conductivity of copper is generally adopted as a standard of comparison. If this is assumed to be 100, then silver rates at 104, gold at 70 and aluminum at 64.5. These four metals are, under ordinary conditions, the best conductors among all the earth's materials.

Even those substances which are classed as nonconductors allow some electrons to pass when the potential is high enough, but they earn the name of insulators if they keep this leakage within practical bounds. Common insulators are vulcanized rubber, bakelite, paraffin, glass, porcelain and mica.

FRANKLIN'S ELECTRIC CHIME



Positive and negative charges are transferred from the knobs A and B of the Wimshurst electric machine to the bells C and D. The clapper hanging from a silk thread swings first toward whichever bell happens to be slightly nearer, say the positive bell C. When it strikes C it receives a positive charge and so is repelled by C and attracted by D. From D it receives a negative charge and swings back again to C. The ringing continues so long as the opposite charges on C and D are maintained. Benjamin Franklin invented this electrical toy.

The term *dielectric* is often used as if it were a synonym for insulator, but it really has a different meaning. It applies to the passage of spark discharges. A substance may be a good insulator in the sense that it will not conduct current, yet it may be a poor dielectric because a spark can break through it easily. Mica and glass, for example, are better dielectrics but poorer insulators than vulcanized rubber and bakelite.

The Electron Flow in Circuits

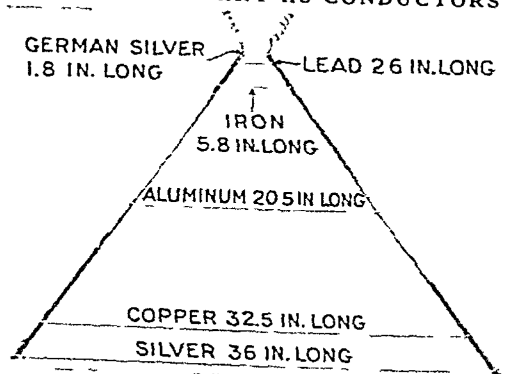
Electrons do much of their work for us while they are moving through circuits; so it is of primary importance to know some of the rules that govern these circuit movements. We have seen that the difference in the concentration of electrons in two places, or potential difference, is what impels an electric current to flow between those two places. This potential difference is often called the *electromotive force* (abbreviated as E.M.F.), particularly when referring to the original force at the battery, dynamo, or other source of electric current.

Now the number of electrons, or as it is commonly expressed, the *quantity of current*, that will flow in a given time between the two places depends upon the resistance this force encounters along the path or circuit that joins the two places.

To describe exactly how electromotive force and resistance affect the rate at which current flows, we must define some practical units of measurement. It would be possible to use the electron itself as a unit, but it would be inconvenient. For example, the number required to operate an ordinary electric lamp of medium power is more than three billion billions per second! Instead, we define electrical units in terms of *effects* produced by an electric current. Any of its effects could serve as a basis, but by common consent the following definite chemical effect has been adopted as the practical standard of electrical measurement.

If an electric current is passed between two silver plates dipped into a solution of silver nitrate, then silver from the positive plate will gradually pass through the solution and deposit itself on the negative plate. For reasons that will be made clear later, the amount of silver thus transferred depends on the number of electrons passing through the solution. And the number of electrons (quantity of current) that will bring about a transfer of .0011181 grams of silver is the standard unit. It is called a *coulomb*, in honor of Charles Augustin de Coulomb, distinguished French physicist of the 18th century. That odd decimal part of a metric unit was chosen so that electrical energy could be readily converted into previously existing units of mechanical and heat energy. It is no more important to remember that figure or that definition than it is to remember that the standard of all measures of length, the meter, is defined as 1,553,163.5 times the wave-length of red cadmium light. But it *is* important to bear in mind that virtually all our units of measurement rest upon conventions of this kind.

HOW METALS VARY AS CONDUCTORS



Each of the pieces of wire shown here has the same resistance as the other five. In other words, a German silver wire 1.8 inches long offers the same opposition to the passage of an electric current as a piece of true silver wire a yard in length. The wires are equally thick.

Amperes, Ohms, and Volts

But we cannot describe the flow of a current in terms of quantity alone; we must know the rate of flow or *current density*. For this purpose we use the *ampere*, which is defined as one coulomb per second. This unit is named in honor of André Marie Ampère, another famous French physicist.

The unit of resistance is defined by international agreement as the resistance at a temperature of 0° Centigrade of a column of mercury exactly 106.3 centimeters long and weighing 14.4521 grams (this makes the cross-section of the column as nearly as possible one square millimeter). This unit is called the *ohm* in honor of Georg Simon Ohm, a famous German physicist.

With the unit of current flow and of resistance definitely settled, it is simple to define the unit of electromotive force. It is that force which will send a current of one ampere (one coulomb per second) through a resistance of one ohm. Its name is the *volt*, honoring Alessandro Volta, the Italian inventor of the electrochemical cell.

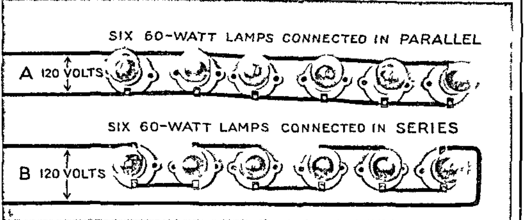
Out of these units is constructed the fundamental formula called *Ohm's law* for calculating any one of the three factors in electrical circuits when the other two are known. Using I to denote the current in amperes, E to denote the electromotive force or potential difference in volts, and R to denote the resistance in ohms, the following mathematical relations express this law:

$$I = \frac{E}{R} \qquad E = IR \qquad R = \frac{E}{I}$$

If you want to know, for example, how many amperes of your 110-volt house current will flow through an electric iron of 20 ohms resistance, you simply divide 110 by 20, and your answer is $5\frac{1}{2}$ amperes.

With Ohm's law as basis, a great many other formulas have been evolved by electrical engineers for computing factors in complex circuits. These are

APPLYING OHM'S LAW TO TWO SIMPLE PROBLEMS



IN the first problem A we have six electric lamps connected in "parallel" to a house circuit in which the *light company maintains a steady voltage of 120* The parallel connection is universal for household fixtures and appliances and it simply means here that each of our lamps is independently wired to the incoming and outgoing lines so that the current it uses does not pass through any other lamp on the way in or out This gives each lamp the benefit of the full voltage *Under this standard condition* the lamps we have selected will draw 60 watts of power Can you figure from this the resistance of each lamp and the amperes that flow through it?

From our main text we know that *watts used in any circuit are equal to* amperes multiplied by volts therefore amperes must be equal to watts divided by volts So we divide 60 by 120 and find that ½ an ampere is flowing through each lamp From Ohm s law we know that the resistance of a circuit or any part of a circuit equals the voltage across it divided by the amperage in this case *120 divided by ½ which gives us 240* ohms resistance for each of our lamps

In problem B six lamps of 240 ohms resistance are connected in series The current on its way in and out has to pass through each in succession Therefore the resistance the *120 volts must overcome with this* arrangement is the total resistance of the six lamps—6 times 240 ohms or 1 440 ohms The rate of flow or amperage according to Ohm s law will then be equal to 120 divided by 1 440 or $\frac{1}{12}$ of an ampere Multiplying this by the voltage we find that all six lamps together would only draw 10 watts of power which would hardly *produce a visible glow in their filaments* To burn these six lamps in series as brightly as the six lamps in parallel would require 720 volts

mathematical short-cuts, employing symbols terms, and conventions that are likely to confuse and mislead the layman who tries to interpret from them the *concrete facts about the behavior of electric currents* Consider, as a simple example of this difficulty, the second equation $E = IR$ on the opposite page Those unfamiliar with its meaning might assume that you could increase the potential difference E in a circuit by increasing the resistance R without altering the current flow, which is, of course, absurd This equation, like the others, merely tells you how the three factors *must be* and are balanced *in a circuit whenever a current flows*

Interpreting the Law of Circuits

A summary of the concrete facts may help to clear up such difficulties In every circuit there is available a definitely limited force (friction, chemical action, or other agency) which sets electrons free In other words, the total number of electrons that this force can pump *out into the circuit per second is limited* If the circuit had no resistance this maximum number would leak away *as fast as produced, none would* accumulate and there would be no such thing in that circuit as potential difference

But under normal conditions all circuits have resistance They will not permit to pass the maximum number of electrons that a given force can set free *So electrons begin to accumulate and the repulsion* they exert on one another builds up a "pressure" As this pressure increases, more and more electrons flow through the resistance, but, on the other hand, fewer and fewer per second are set free, for the task of setting them free against the pressure grows harder This continues (the whole taking only a tiny fraction of time) until the number of electrons that are set free *each second exactly equals the number that are getting* through the resistance At that point the pressure remains fixed

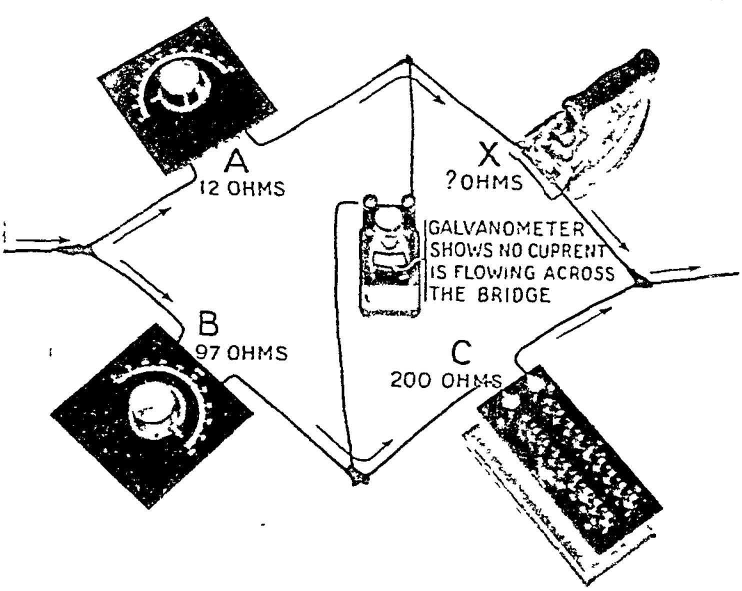
Now the pressure required to balance the pumping force against the resistance is the potential difference or *voltage* of the circuit, and the number of electrons that are flowing at an even rate in all parts of the circuit constitute the *amperage* or current density (commonly called simply the "current")

You may think of what happens in these terms The *force generating* the current expends itself partly in overcoming the resistance of the circuit (thus building up the voltage), and what remains of that force is used

up in producing free electrons. It is evident that no more voltage is produced by the process than is exactly sufficient to drive those electrons through the total resistance of the circuit. So that whatever the voltage may be at the starting terminal, it always becomes zero at the return terminal.

The resistance of the circuit is not, of course, concentrated in one place but is distributed throughout the circuit, a small amount in the conducting wires, larger amounts in the apparatus or other working devices; for it is an axiom of electrical action as it is of mechanical action that where work is done, a proportional amount of resistance must be overcome. In overcoming each item of resistance in the circuit, the current loses a definite part of its voltage. This is often called in technical descriptions of electric circuits the "voltage drop across" that item, or simply the "voltage across" it.

MEASURING RESISTANCE WITH A WHEATSTONE BRIDGE



The famous bridge circuit, shown here in practical application, is one of the most accurate methods for determining the electrical resistance of an object. The object here is an electric iron X. This is connected, as you see, with three variable "resistors" or "rheostats" A, B, and C, to any moderate source of direct current. Across the middle of the bridge is wired a galvanometer of the type that will show current passing in either direction, like an automobile ammeter. The variable resistors are carefully adjusted until the galvanometer needle stands at zero, showing that no current is passing through the middle wire. This tells us that the voltage drop across A is the same as that across B, and that the voltage drop across X is the same as that across C. We know, on the other hand, that the amperes through A equal those through X, since no current flows across the bridge; similarly that the amperes through B and C are the same. Applying Ohm's law formulas, and canceling out equal voltages and currents, we reach the conclusion that the ratio of the resistance of A to the resistance of X is the same as that of the resistance of B to the resistance of C. The ratio of 97 to 200 is 2 06. Multiplying 12 by 2.06 gives us 24.7 ohms as the resistance of the iron. The resistor C is adjusted by pulling out one or more of its plugs; the other two resistors are of the revolving contact type.

No electrons are ever "lost" in a circuit. The number that leaves one terminal of a generator of current is always equaled by the number that reaches the other terminal. It is only their voltage that is used up. But we must not assume on that account that the voltage in a circuit is alone a measure of the *power* in that circuit. You must know also how many electrons per second or amperes are pushing through that circuit. The electrons do the real tangible work in the circuit; but in order to do it, they must be moving. The voltage provides that motion and nothing else.

The Watt, Unit of Power

Thus electrical power is defined as *the product of the current density and the potential difference.* The standard unit of electrical power is the *watt*, named in honor of James Watt. To find the watts of power that are passing through a circuit or device we *multiply the amperes by the volts.* The various kinds of instruments for measuring volts, amperes, and watts are described in the article on Galvanometer.

The proportion of amperage to voltage in a circuit can be altered by devices which will be described later, but the product of the two must always remain the same, unless more power is applied to the production of electrons at the source. From the same battery, an automobile derives currents of extremely high voltage (from 8,000 to 15,000 volts) but of relatively low amperage for delivery to the spark plugs of its engine, and currents of low voltage but extremely high amperage for driving the starting motor.

Electricity is commercially supplied by power houses at fixed voltages. These voltages are maintained by suitable controls which increase or decrease the power applied to the electric generators as more or less current is drawn from the supply lines by the users. For domestic use 110 to 120 volts is customary, though some cities are supplied with current at 220 volts. The resistance of all devices, lamps, motors, heaters, etc., must be adjusted so that the standard voltage will drive through each device the current it requires for proper operation. A lamp designed for a 110-volt circuit will let through so much current on a 220-volt line that the filament will burn up. On the other hand, a lamp designed for 220 volts will shed only a feeble glow if it is connected to a 110-volt line.

Electricity and Solutions

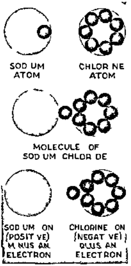
One of the first experiments described in this article showed us that an electric current can be produced by dipping two metals into an acid solution. The whole field of the electrical behavior of chemical solutions is

an extremely interesting and important one which is surveyed in the article on Electrochemistry Here we need to consider only those principles that will help us to draw a contrast between solutions and solids as generators and conductors of free electrons

We will take our original example involving copper zinc and sulphuric acid Before the metals are put into the solution the sulphuric acid (H_2SO_4) is already partly *dissociated* This means that some of the hydrogen atoms and sulphate particles (SO_4) that make up the molecules of the acid have broken apart a common result of dissolving chemicals in water as the neighboring illustration shows But the break between hydrogen and sulphate is under such conditions not a simple clean cut break For certain reasons growing out of chemical valence or affinity (*see* Chemistry) each sulphate particle runs off with two electrons belonging to the two hydrogen atoms with which it was previously associated Those two excess electrons constitute a negative charge and in that condition we call the sulphate particle a sulphate ion and express its charge with the symbol SO_4^{--} On the other hand each of the hydrogen atoms having lost an electron has become a positively charged hydrogen ion with the symbol H^+

These negative and positive ions are continually recombining and dissociating again in the solution but at any given moment there are always equivalent *quantities of each so that the solution* as a whole is electrically neutral

EVOLUTION OF IONS



The general principle of dissociation and transfer of electrons in solutions is illustrated here with a standard example The outer shell of an atom of sodium is composed of a single electron that of a chlorine atom consists of seven electrons For reasons explained in the Chemistry article when the sodium atom and the chlorine atom combine to form a molecule of common salt the single electron from the chlorine seems to act as the binder between them And when the sodium chloride molecule goes into solution and dissociates the chlorine keeps that electron and the two atoms become ions

How Electrons Are Freed

Now let us see what happens when we put our plates of zinc and copper into the solution As the article on Electrochemistry shows metals vary greatly in their chemical activity and this variation is closely associated with the readiness of their atoms to part with some of their electrons Zinc is a much more active metal than copper and when it comes in contact with the acid solution quickly starts to dissolve in it But the zinc atoms cannot go into solution with all their electrons each atom must leave two electrons behind and so become a positively charged zinc ion (Zn^{++}) No sooner does this happen however than some of the zinc ions encounter some of the negatively charged sulphate ions and promptly combine with them to form neutral molecules of zinc sulphate—a combination that sticks together in the solution much more tightly than the original one between the hydrogen and the sulphate

The net result of this chemical reaction is that the abandoned electrons accumulate on the zinc plate producing there a negative charge while the neutralization of some of the sulphate ions in the solution itself leaves there a preponderance of hydrogen ions constituting a positive charge

You may ask why the electrons on the zinc plate do not flow back into the solution since the latter is positive Because the interplay of chemical forces that set those electrons free maintains a definite barrier like the action of a pump dividing the negative *and positive areas A one-way action of this type* must necessarily exist wherever and whenever an electric current is generated Presently however what we may call the back pressure of the accumulated electrons on the zinc plate grows until it balances the chemically generated forward force zinc ions can no longer break loose from the plate and the system comes to rest

In the meantime no such activity takes place at the copper plate The greater tenacity of copper for its electrons coupled with the increasing positive charge of the solution itself prevents positive copper ions from forming

Releasing the Electron Flow

The next step is to see what happens when we connect the zinc plate to the copper plate with a wire The accumulated free electrons will of course flow from the zinc plate through the wire and down to the copper plate There they immediately attract the positively charged hydrogen ions As soon as these ions touch the plate each one collects an electron and turns into a *neutral* hydrogen atom *These atoms* form into gas bubbles rise to the surface and pass out of solution into the air This removal of electrons partly relieves the pressure at the zinc plate leaving only what is due to the resistance of the wire whereupon the chemical action starts up again and a steady electric current flows

All electric *cells* and *batteries* operate in this or in some similar way The metals used for terminals may differ and the solutions may differ the chemical action may be a reversible one so that cells may be recharged when they have run down as in the case of storage batteries but the principle is always the same—a roundabout exchange of electrons between two substances brought about by the net difference between the forces of two or more chemical reactions This net difference is used up in moving electrons around the circuit against whatever resistance they may meet This explains why the voltage of a cell is always limited A large cell will yield a greater *number* of amperes than a small one but its potential difference can never rise beyond the point where its pressure halts the chemical action Useful as batteries are, if we had

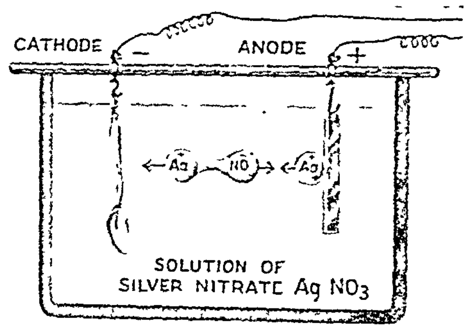
been compelled to rely solely on chemical action for our supply of electric power, electricity would never have transformed our civilization as it has done. Batteries are of use principally as temporary or stand-by sources of electricity (*see* Battery).

What Electrolysis Means

We have just seen how chemical action in solutions produces an electric current. Let us now examine the reverse process, namely how a current, generated independently, will produce chemical action when it passes through a solution. This process is called *electrolysis*. The conductors that dip into the solution are called *electrodes*, instead of terminals, the negative electrode being the *cathode* and the positive electrode the *anode*. The solution is the *electrolyte*.

As a type of all electrolytic action, we may consider the example already cited in defining the coulomb. Here two silver plates are immersed in a solution of silver nitrate ($AgNO_3$). The silver nitrate, like the sulphuric acid in the case of our cell, is partly dissociated in the solution before any current is applied. It forms positive silver ions (Ag^+) and negative nitrate ions (NO_3^-). Notice that the single plus and minus signs indicate that only one electron has changed hands in this ionization, instead of two as was the case with the formation of the zinc and sulphate ions. This illustrates merely a difference of chemical valence, and has no effect whatever on the general principles under discussion.

SILVER PLATING A SPOON



The rod across the top of the tank is made of wood or other non-conductor. The bar of silver is connected to the positive terminal of a battery, the spoon to be plated to the negative terminal. The accompanying text tells what happens in the solution when two silver plates are used. The substitution at the cathode of a spoon of some other metal than silver does not alter the action in any important sense. For technical reasons, commercial silver plating is done with a solution of silver cyanide instead of silver nitrate.

As soon as a source of electric current is connected to the two silver plates, the positive silver ions in the solution move toward the negative or cathode plate, where each acquires an electron. This turns the ion to an atom of metallic silver which deposits itself on the cathode. Meanwhile the negative nitrate ions have migrated to the positive or anode plate, where silver ions break away to meet them, neutralizing their charge. The electrons left behind on the anode by these newly-formed silver ions travel around to the source of the current and there are "pumped" out again on the negative side down into the cathode, where they turn additional silver ions into a deposit of silver atoms.

In time, the anode plate is eaten away and an equivalent amount of silver is deposited on the cathode. Since the nitrate ions remain in solution, and a silver ion is produced at the anode for every one that goes out of solution at the cathode, the chemical composition of the solution itself undergoes no change.

Similar reactions take place with other metals and their compounds. In copper plating, for example, the anode is a copper rod and the solution is copper sulphate. Chrome plating takes place in a bath of chromic acid (*see* Electroplating; Electrotyping). By a related process aluminum and other metals are separated from their ores (*see* Aluminum).

The electrolysis of water separates it into its two elements, hydrogen and oxygen. Pure water is a poor conductor of electricity and so it must have dissolved in it an acid, base, or salt. When the electric current is passed through it, hydrogen bubbles up at the cathode and oxygen at the anode. Hydrogen is commonly prepared this way.

How Heat Makes a Current Flow

The relatively greater freedom with which electrons leave some metals than they do others accounts for the fact, observed in one of our preliminary experiments, that heat applied to the junction of a copper and an iron wire in a circuit will cause an electric current to flow. In the case of these two metals, the electrons pass across the heated joint from the iron to the copper. At ordinary temperatures electrons tend to flow from iron to copper when they are in contact, but a circuit made up of the two has, of course, a second junction of the metals where the electrons tend to flow from iron to copper in reverse direction, and the two tendencies neutralize each other. Heat at one of the junctions, increasing as it does the motion of the molecules of the metals (*see* Heat) seems further to loosen the electrons and to give them sufficient added impetus at that point to overcome the back pressure at the other junction. Although not practical for generating large currents, this action takes place with very small changes in temperature, and hence is applied to sensitive heat-measuring devices (*see* Pyrometer; Thermometer).

Virtually all electric effects are reversible. So it is not surprising to learn that if electrons from an external source of current are forced across the junction from copper to iron, the junction will become warmer than the rest of the circuit.

How Electricity Produces Heat

Most important, however, of all *thermoelectric* effects, as interactions between heat and electricity are called, is the general rise in temperature that takes place whenever a current flows through a conductor. The heat is due to the friction-like disturbance produced by the moving electrons. If you could measure the temperature of an ordinary electric lamp cord, you would notice a rise when the light is turned on. The filament of the lamp itself, which offers higher resistance, gets so hot that it glows.

Many types of electric heaters from curling irons to giant electric furnaces work on this principle So do the electric fuses that prevent our house wiring from being burned out when a short circuit occurs The term short circuit is applied to any connection in a circuit that permits the current to flow around an electrical device or piece of apparatus instead of passing through it If the cord to a lamp or a flat-iron is worn bare so its two wires come into contact with each other you have a short circuit Since there is very little resistance in the wires alone a tremendous current begins to flow which if it were not shut off would quickly heat the wires red hot melt some of the connections in the walls or perhaps set fire to the house But all house circuits pass through fuses usually grouped in a fuse box in the basement and these fuses contain wires made of an alloy that melts at low temperatures (*see* Alloys) Before the sudden rush of current can do any damage one of these wires melts and breaks the circuit

It is worth remembering that the heat generated in a conductor of a given resistance increases as the *square* of the amperage If you double the amperes you quadruple the heat. This is why power companies transmit current at high voltages and low amperages Less energy is dissipated in the form of heat (*See* Electric Light and Power)

Electricity and Magnetism

The relation between electricity and *magnetism* is one of the most fascinating aspects of science It has made possible furthermore the lavish supply of electric power upon which modern life is so dependent

In exploring this field the *direction of current* must continually be taken into consideration So we must recall the conventional distinction previously explained between electron movement and current flow Throughout the ensuing discussion direction of current will always mean from positive to negative—the reverse of electron movement

In 1820 the famous Danish chemist Hans Christian Oersted proved that an electric current moving through a wire will affect a near by magnet The effect is definite and easily tested Hold such a wire in front of you with your two hands and let the direction of current be *from* your *left* hand toward your right Now bring the wire close *above* a compass The needle of the compass will at once set itself at right angles to the wire and the north pole of the needle will be pointing *away* from you (Fig 1) If you will now contrive to hold the wire in the same way *beneath* the compass the needle will promptly turn around, so that its north pole is pointing *toward* you

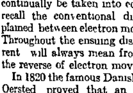


Fig 1

Compass needle shows polarity of electric current in a wire

Examining a Magnetic Field

To understand the importance of this effect we must have clearly in mind certain facts about magnets By agreement among scientists the name *north pole* or *positive pole* is given to that end of a magnet which is attracted by the north pole of the earth The other end is called the *south pole* or *negative pole* The space surrounding a magnet throughout which its influence can be detected is called its *magnetic field* And this influence is commonly described as being due to *lines of magnetic force* that traverse the field The direction of these lines of force is assumed to be outward from the north pole and inward to the south pole

Now whenever two magnets are brought near each other so that their magnetic fields can interact they tend to arrange themselves so that the lines of force in the two fields will be moving in the same direction In other words the north pole of one magnet will point in the direction in which the lines of force of the other magnet run A moment's reflection shows that this is simply another way of stating the formal law that unlike poles attract each other while like poles repel each other (*See* Magnet)

If we go back now to our electric current and compass we see at once that when the current is flowing through the wire it must be setting up around the wire lines of magnetic force to which the compass needle adjusts itself From the way the needle points when the wire is above it and from its reversal when the wire is below it we know the direction of those lines of force Perhaps the easiest formula to remember is that *if you sight along a wire in the direction in which the current is flowing the lines of force circle the wire clockwise* (Fig 2) This is an extremely important rule

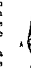


Fig 2

Making a Magnetic Coil

The magnetic force at any point along a single wire carrying a moderate current is relatively feeble But it is evident that if we can concentrate into a small space all the lines of force throughout a long wire we can get a force great enough to be useful This is easily accomplished by winding the wire into a coil When this is done the lines of force instead of remaining as small circles around each section of wire tend to join together and form a large magnetic field circling the entire coil (Fig 3)

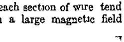


Fig 3

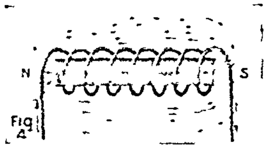
The dotted lines indicate the magnetic lines of force emerging from the north end of the coil curving around it to form a single large field and entering the south end.

The strength of the lines of force around a single wire depends upon the quantity of current (amperes) flowing through it When the wire is wound into a coil of say 50 turns the effect is much the same as if you had a single wire with 50 times the amperage flowing through it The term *ampere-turns* denoting the number of turns of wire in the coil multiplied by the amperes flowing through each turn is used to describe the magnetic strength of such a coil

It is evident that the arrangement of the turns in a coil will influence the distribution of the magnetic field A common form for experimental purposes is called a *solenoid* (from the Greek meaning tube-like) It is usually wound on a cylinder of cardboard or bakelite and consists of one or at most a few layers of wire arranged like thread on a spool

We said above that the magnetic lines of force around the individual turns of wire in a coil ' tend to join together to form a single magnetic field around the coil But not all of them can succeed Many of those emanating from the middle wires of the coil exhaust their strength and break down, so to speak before they can complete the long journey around the

coil. This is due to the comparatively low *magnetic permeability* of air. The permeability of a substance for magnetic lines of force is something like the conductivity of a substance for an electric current. Soft iron is the most permeable in this sense of all ordinary materials. If we insert into the middle of our coil a piece of soft iron (Fig. 4), far more lines of magnetic force will become concentrated at the ends of the coil and throughout the entire field than before, because they encounter less resistance in traveling through the iron than in traveling through the air. The insertion of this iron "core" turns our magnetic coil into an *electromagnet.* Reversing the current in the coil reverses, of course, the polarity of an electromagnet. How the soft iron core responds almost instantly to this reversal is explained in the following paragraphs.



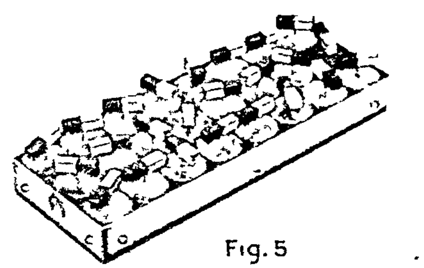
The increased number of dotted lines indicates the effect of the iron core. To determine the polarity of a coil, grasp it in the right hand, so the fingers point in the direction of current flow. The thumb will then be toward the north pole.

Magnetic Action of Iron Atoms

We have seen that the moving electrons which constitute an electric current generate magnetic lines of force. The atoms of all substances, according to the modern atomic theory, are surrounded by electrons traveling in orbits like the planets around the sun. Each of these moving electrons is believed to set up lines of force in its vicinity. But in all atoms except those of iron, nickel, and a few other "magnetic metals," the revolving electrons seem to follow such divergent paths that the lines of force they set up cancel one another. Those revolving around the iron atom, however, appear to be moving more or less in the same direction, and the result is to turn each atom into a tiny electromagnet.

In an ordinary piece of soft iron these atom-magnets are pointing in every possible direction, just as would happen if you threw a large number of small bar magnets down on top of a table. But when the piece of iron is put into a magnetic field, like that of our coil, the atoms straighten out along the lines of force and add their effect to the total. The accompanying pictures (Fig. 5 and Fig. 6) show models specially designed to illustrate this action. In soft iron the atoms are loosely packed and lose their regular magnetic pattern as easily as they acquire it. Those in the core of an electromagnet whirl end-for-end the instant the current is reversed. Hard steel, with its closely packed atoms, acquires magnetism less easily, but the effect is more permanent.

THE ATOM-MAGNETS IN A PIECE OF IRON



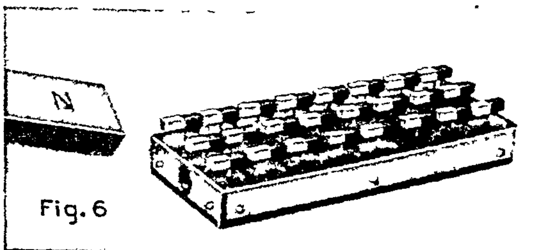


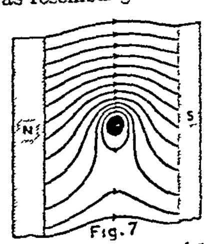
Fig. 5 is a model in which small magnets suspended on pivots represent the atoms in an unmagnetized piece of soft iron. They point, as you see, in random directions. Fig. 6 shows the effect of a magnetic field on the piece of iron. The atoms line up, their south poles toward the north pole of the big magnet. In this condition the piece of iron becomes itself a magnet.

How Magnets Produce Currents

We have just seen how an electric current can be used to produce a magnet. At the beginning of this article we saw that a magnet can in turn produce an electric current. Let us examine briefly the mechanism of the latter effect. It takes place, as we know, when a wire or other conductor *moves* through a magnetic field. The result is the same, of course, if the magnetic field moves while the wire remains stationary. The essential factor is that the wire and the lines of magnetic force shall *cut across each other,* for if the wire moves lengthwise through the field or if it moves in the same direction as the lines of force, no current is generated.

The current generated when a conductor cuts across lines of magnetic force is called an *induced* current. The principles of *electromagnetic induction* were discovered in 1831 by Michael Faraday. That same year, Joseph Henry, who had been working independently on the problem, made many important additions to Faraday's results.

The direction of an induced current and the forces that cause it are best understood by examining Fig. 7, where we see the cross-section of a wire moving upward through the field of a magnet. It was Faraday's suggestion that we think of the lines of magnetic force that pass from the north pole to the south pole of a magnetic field as resembling invisible rubber bands that would stretch up around the wire as we see them doing for a considerable distance before they break and reform again below the wire. Now the crowding together of the lines at the top of the wire produces a partially circular field around it in which the direction of the lines is clockwise. Look back



Effect of a wire moving across a magnetic field.

at Fig 2 and you see that clockwise lines of force are the *result* of a current moving away from you in the direction of your gaze In the case of Fig 7, the clockwise lines of force are the *cause* of a current moving in that same sense As soon as the induced current begins to flow, it produces lines of force that coincide with those that induced it A quick way of determining the direction of an induced current without the need of reflection, is the "three-finger rule" With the right hand held as in Fig 8 point the thumb in the direction in which the wire is moving across the magnetic field, the index finger in the direction of the lines of force, and the middle finger will point in the direction of flow of the induced current

Fig 8

The Field Resists the Wire's Motion

The amount of current induced in a wire will depend upon the number of lines of force the wire cuts per second Therefore the more numerous the lines of force (that is the stronger the magnetic field) and the faster the wire moves through that field the greater will be the current Also, if instead of a single wire we move one side of a coil through the field we increase the current in proportion to the number of turns of wire in the coil

It might appear, then that all we need to produce a boundless supply of electricity is some device for sending wires whizzing through magnetic fields One thing interferes with this vision of 'free power" The greater the current induced in a wire moving through a magnetic field, the more force is required to push it through The lines of force in the field and the lines of force produced by the induced current are moving in the same direction and hence tend to thrust each other apart, just as two bar magnets laid side by side with their poles pointing in the same direction will thrust each other apart This principle is known as *Lenz's law* It explains why we have to hitch powerful engines to the generators that produce our electricity. And the more electrical power we wish to draw from them, the more mechanical power we have to apply

The reader should turn to the article on Electric Generator and Motor to familiarize himself with further practical details in this field

Peculiarities of Alternating Current

Much of the current in practical use in the world is of the type called *alternating* (abbreviated A C). This is simply a current that reverses its direction of flow at rapid intervals Starting from zero it increases to maximum in one direction, and decreases until it returns to zero, then it increases to maximum in the other direction and returns once more to zero. The complete movement just described is called a *cycle*, consisting of two alternations

Why alternating current is easier to produce than direct current (D C) is made plain in the article on Electric Generator and Motor Here we will merely examine some of its peculiar properties

A moment's thought will make it evident that when a current is increasing in a wire, the magnetic lines of force around the wire are increasing also—spreading out, so to speak, into the surrounding space, and that when the current is decreasing the lines of force are drawing in again Around a wire carrying an alternating current, therefore, lines of force are continually expanding and contracting

If we place another wire close beside this first wire, lines of force will be continually cutting through it, first in one direction and then in the other, although neither wire is moving We know from our foregoing examination of electromagnetic induction that this will result in setting up an induced alternating current in the second wire The same will hold true in greater degree if a coil of wire is placed beside another coil in which an alternating current is flowing Upon this principle are based the induction coil and the electric transformer (*see* Transformer)

Self-Induction and Inductance

What is called *self induction* takes place within a single coil when an alternating current flows through it For the expanding and contracting lines of force around any one turn of wire in the coil are cutting through neighboring turns The tendency of this self induction is to set in motion a current which, in accordance with Lenz's law, will oppose the movement of the first current When the first current is increasing in either direction, self induction will tend to hold it back, and when it is decreasing, self induction will tend to make it continue to flow In brief, self induction gives the current a kind of *inertia*

Self induction cannot, of course, actually produce a reverse current, but it does produce what is called a "back voltage" or "counter electromotive force" which decreases the forward flow of current The amount of back voltage in a coil depends on the number of turns of wire, their arrangement, the quantity of current flowing, and the rate of change The result of these factors is the *inductance* of the coil

The Operation of Condensers

To understand the next peculiarity of alternating currents, let us first consider what is going on in Fig 9 The positive charge on ball A causes a negative

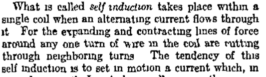


Fig. 9

The ball A receives its positive charge from a Wimshurst machine Ball B has no active electrical connection.

charge to accumulate on ball B, as soon as you touch B with your finger or with any other conductor in contact with the ground But as the negative charge on B begins to grow, it helps in turn to increase the

positive charge on A, since it tends to repel the electrons remaining there. This reacts once more on B, and so on until A accumulates a larger positive charge and B a larger negative charge than would be possible if each of them stood alone.

This method of increasing a charge in a body is called *electrostatic induction;* and the two balls constitute together what is known as a *condenser.* Their joint action is to concentrate or "condense" an excess of electrical energy into a given area. The measure of energy that a given condenser will accumulate is called its *capacity.* For practical purposes condensers are usually made of flat plates parallel to one another. This increases the interaction between them.

If a condenser is connected to a source of direct current, the current will flow into it until the capacity of the condenser is satisfied and will then cease. Not so if an alternating current is used. The latter will surge in and out of the condenser, first from one direction, then from the other; and the amount of current that will flow in the circuit will depend largely on the condenser's capacity.

Consider Fig. 10, disregarding for the moment the purpose of the coil (I). If the condenser (C) is large enough, the lamp (L) will burn, even though the continuity of the circuit is broken by the condenser.

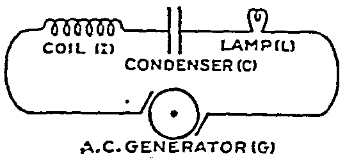


Fig. 10

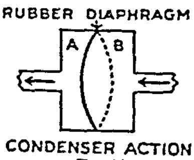


Fig. 11

The position of the various units in this circuit could be reversed without materially changing the results described.

Although no actual current can flow across at that point, the attractive and repulsive force of the current (the electromotive force) does bridge the gap.

We may compare a condenser to a circular chamber (Fig. 11) divided across the middle by a diaphragm of sheet rubber, forming two compartments (A and B). The A.C. generator may then be compared to an air pump first drawing air out of one compartment and driving it into the other, then reversing its action. When the air is moving in the direction indicated by the arrows, the diaphragm is not only being *pushed* to the left by the pressure in compartment B, but is also being *drawn* in the same direction by the suction in compartment A, so that it bulges to the limit of its capacity. When the pressure-suction is reversed, the diaphragm bulges similarly in the opposite direction.

But here is an important point to notice. When the reversal of pressure takes place, the movement of air out of compartment B and into compartment A is speeded up at first by the fact that the diaphragm is stretched and wants *of itself* to return to the midpoint of the chamber. So up to that midpoint (and a little beyond, because of its momentum) it *helps* to drive the air out of B and to draw it into A. Condensers play much the same *elastic* part in circuits.

We are now prepared to understand the contrasting influence in an A.C. circuit of an inductance (coil) and a capacity (condenser). In Fig. 10, for example, when the current starts to surge back into the left side of the circuit, the inductance (I) with its effect of inertia tends to slow it down at first, but once it is flowing tends to prevent it from stopping. The capacity (C), on the other hand, with its elastic effect, tends to speed up the surging current at first; but after it has crossed beyond the zero point in the opposite direction tends to slow it down.

Uses of Inductance and Capacity

These two opposing tendencies are applied in many useful ways to A.C. circuits. Between them they determine the *frequency* (number of cycles per second) which will pass most readily through a circuit. This is made plain in the following comparison.

We know that if a piece of spring steel is clamped in a vise and then is bent and suddenly released it will oscillate back and forth at a fixed rate. This rate is called its *natural vibration period,* and is determined by the mass (inertia) of the spring, which as it increases tends to slow down the rate of vibration, and by the elasticity which, as it increases, tends to speed up the vibration. It is, of course, possible for an outside force to bend the spring back and forth at some other rate than its natural vibration period; but the nearer we approach to the latter, the more help we get from the spring.

Alternating current circuits likewise have a natural vibration period determined largely by the total inductance and capacity in the circuits. The nearer the frequency of the current that is to pass through a circuit comes to the circuit's natural period, the more easily it will be transmitted.

When the natural vibrating period of a circuit and the frequency of the current passing through it are exactly the same, they are said to be in *resonance* with each other. This is important in the "tuning" of radio transmitting and receiving sets (*see* Radio).

Another application is in ordinary long-distance telephone work. A condenser effect is inevitably present between the transmission wires and the ground, and this tends to establish a resonance that will magnify certain sound frequencies that pass over the wire and diminish others, resulting in what is called "distortion" of the message. By inserting into the line suitable inductances called "loading coils," the undesired resonances can be eliminated.

Here are some facts to remember about condensers: To avoid excessively large condenser plates, most condensers are made of two sections of several plates each, which are interleaved with some dielectric material (defined earlier in this article) between them. Mica is the dielectric commonly used for small condensers. The closer the plates are to one another the higher is the capacity, so the mica is made as thin as is possible without incurring the danger of a spark breaking through it. The higher the voltage across the condenser, the stronger must be the dielectric strength of the substance between the plates. The term *dielectric constant* applies to the ability of a substance to transmit the lines of electrical attraction and repulsion (not to be confused with magnetic lines of force) between the condenser plates. So the material used between the plates may increase or decrease the condenser's capacity. The dielectric constant of air is only about one-third that of mica.

The unit of capacity is the *farad,* and is defined as the capacity in which a charge of one coulomb will produce a potential difference of one volt. It is far too large a unit for practical use. The *microfarad* (one-millionth of a farad) is the usual unit. The unit of inductance is the *henry.* One henry will produce one volt of counter E. M. F. when the rate of change in current flow is one ampere per second.

It is evident that the inductance of a coil adds to its effective resistance. In other words, an alternating current has greater difficulty getting through a coil than a direct current. For this reason the application of Ohm's law to alternating circuits is often complicated.

The Men Who Discovered Electricity's Secrets

WHEN Thales of Miletus, one of the Seven Wise Men of Greece (about 600 B C.) noted that amber, jet, and a few other substances, had the power when rubbed of drawing to themselves bits of leaves, straw, or feathers, he made the first discovery of electricity.

OTTO VON GUERICKE
Inventor of the First Electric Machine

Pliny the Elder, a Roman who wrote a famous 'Natural History' in 70 A D, tells of similar experiments, and also of painful "shocks" felt by persons who touched the torpedo-fish It did not occur to him that both phenomena were due to the same cause

There was little except scattered and useless information until the 17th century Then Dr William Gilbert (1540–1603), physician to Queen Elizabeth, wrote 'De Magnete' telling of many experiments with lodestones and the magnetic compass He showed that the attractive force of amber, jet, wax, glass, and other substances when rubbed was not magnetic This attractive force he called "electric," a word derived from the Greek name for amber (*elektron*).

The First Electric Machine Invented

Otto von Guericke (1602–1686) mayor of Magdeburg, Germany, earned a place in the history of electricity by inventing the first electric machine, a sulphur ball mounted on a shaft and rotated by a handle while rubbed by the operator's hand, thus producing electric sparks He also discovered that electrified objects touched to non-electrified ones transfer some of their electricity.

Stephen Gray (1696–1736) showed that some substances are conductors of electricity and others are not He suspended a thread 800 feet long by loops of silk and sent over it a current of electricity produced by rubbing glass

GALVANI
Who Learned About Electricity from a Dead Frog

In France, C F de C. du Fay (1699–1739) was first to distinguish between what we now call positive and negative charges He believed these were due to two different kinds of electricity and originated the term "vitreous" for the positive and "resinous" for the negative He found that objects charged with the same "kind" of electricity repel each other, but attract objects charged with the other kind

Up to this time no one had succeeded in making and storing up electricity for use at will. But about 1745 a German clergyman, E G von Kleist, and a professor in the University of Leyden, Pieter van Musschenbroek, conceived the same idea independently *The first 'Leyden jar" consisted simply* of a glass vessel filled with water, which was charged by frictional methods Later, Sir William Watson (1715–1787) and Dr John Bevis (1695–1771) improved it to the form still used in classroom demonstrations, consisting of a glass jar coated inside and out with tinfoil, and capable of accumulating a heavy charge on the inner coating when the outer coating bears an opposite charge

OERSTED
A Genius of the Magnetic Needle

Watson demonstrated that gunpowder could be exploded and alcohol ignited by a spark from a charged Leyden jar His most important experiment was that in which he found that electricity seemed to travel almost instantaneously to the end of a two-mile wire.

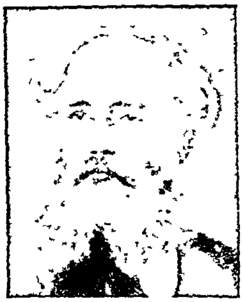
Franklin's Great Experiments

In 1752 Benjamin Franklin brought America into the history of electricity by his famous experiment with the kite Franklin had observed an important fact—that electricity is most easily discharged from and collected by points—and desired to prove the identity of electricity and lightning by collecting the latter in a Leyden jar Accordingly he flew a silk-covered kite, surmounted by a pointed wire to collect the electricity, during a thunderstorm The wet kite string, conducting the electricity, was insulated from his body by means of a length of dry silk ribbon, and a door key was suspended at the end of the wet string Soon electricity was conducted downward so that when Franklin brought his knuckle near the key a spark flew out On that memorable day in June 1752, Franklin collected enough electricity to charge a Leyden jar, and his later experiments proved that it was in all respects the same as electricity produced by friction This experiment suggested the lightning rod to Franklin Later he was able to demonstrate that some clouds have positive and some negative electric charges (*see* Franklin, Benjamin, Lightning)

VOLTA
First Producer of Current Electricity

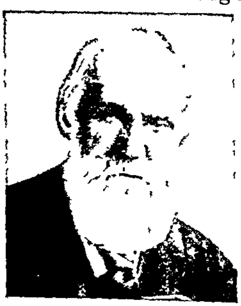
Following Franklin, many experimenters added to the sum total of knowledge bit by bit John Canton (1718–1772), an Englishman, discovered electrostatic

induction, by which an electrified body produces an electric charge in another insulated body. Francis Aepinus (1724–1802), a German professor, extended Franklin's theory to account for magnetism. Others proved that the "shocks" given by such animals as the torpedo fish are shocks of electricity manufactured in the animal's body.


JAMES C. MAXWELL
Father of the New Wave Theory

The eccentric Henry Cavendish (1731–1810) lived only for scientific research and was even indifferent to the publication of his important findings, some of which remained unknown for many years after his death. He discovered the law that the force of electric attraction between bodies varies inversely as the square of the distance separating them. This was called Coulomb's law, named for the French engineer Coulomb (1736-1806), who worked out the law independently a little later. Cavendish also anticipated by nearly 50 years the discovery by Georg Simon Ohm (1787–1854) of the fundamental law of electric flow, known as Ohm's law.

Coulomb's mathematical studies of the laws which express the actions of electrostatic forces provide a logical close for this initial period of study and experiment. It had brought understanding to the viewpoint, developed largely by Watson and Franklin, that electricity was some sort of mysterious fluid. Two kinds had been identified experimentally—*vitreous*, produced by rubbing glass with silk, and *resinous*, produced by rubbing resin with wool or fur. But Watson and Franklin thought that perhaps only one kind existed, and was present in all bodies. In normal amounts, it was neutral—that is, it produced no electrical éffects. But friction could transfer it from place to place. This left a deficit (— or negative charge) in one place and an excess (+ or positive charge) in the other. Electrical effects were caused by the tendency of the excess to make good the deficit. Franklin identified the vitreous charge with + and the resinous with —, although he acknowledged that no basis for the choice existed.


WILLIAM THOMSON
Explorer in the Great Field of Electrochemistry

Galvani, Volta, and Current Electricity

This view is curiously prophetic of the modern theory, based upon electrons, as explained earlier in the article. It might also have been a dead end for advance of knowledge, as long as experimenters were limited to working with frictional devices. But the first year of the 19th century brought a revolutionary discovery, which provided the means for swift advance. Two Italian professors discovered a means for producing a steady, powerful *current* of electricity.

Luigi Galvani (1737–1798), a professor of anatomy thought he had discovered a means of producing "animal electricity," by touching the nerves of a dead frog with dissimilar metals. Count Alessandro Volta, professor of physics, thought that the frog merely provided moisture, and solutions of salts or acids would do as well. He developed his idea brilliantly into the first electric battery (*see* Battery).

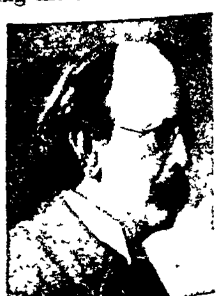

HEINRICH HERTZ
Forerunner of Marconi in Wireless Telegraphy

These discoveries foreshadowed the great link that was to be established later between chemistry and electricity. William Nicholson (1753–1815) in 1800 decomposed water by the voltaic current into oxygen and hydrogen. Sir Humphry Davy (1778–1829) later discovered the elements potassium and sodium by electrolizing fused potash and soda.

The steady, powerful current which the battery could provide also opened the way for other discoveries. In 1801 Davy discovered the principles of the arc light. A few years later other experimenters uncovered knowledge which led in time to electric generators, motors, and other electrical machinery.

Magnetism Linked with Electricity

In 1820 Hans Christian Oersted, professor of natural philosophy at the University of Copenhagen, confirmed the suspected relationship between electricity and magnetism by announcing his discovery of the deflection of a magnetic needle by an electric current. The significance of this discovery was recognized immediately by others. The French academicians André Marie Ampère (1775–1836) and D. F. Arago (1786–1853) announced the fundamental laws of *electrodynamics*, which was to give the world in later years the electric motor, the telephone, and many other inventions.


SIR J. J. THOMSON
Father of the Electron Theory

A few years later an Englishman, William Sturgeon, constructed an electromagnet; it was improved by the American physicist Joseph Henry (1797–1878), thus inventing in principle the electric telegraph, although another American, S. F. B. Morse (1791–1872), perfected it.

Michael Faraday (1791–1867), an English chemist, like his master Sir Humphry Davy, attacked electrical problems with tremendous imagination and for 34

years made many important discoveries in electromagnetism In 1831 he discovered the principle of the induction coil (*see* Transformer) and of the electric dynamo (*see* Electric Generator and Motor) He demonstrated that electricity, no matter what the source, is identical in nature

William Thomson, who later became Lord Kelvin (1824-1907) brought precision and order into electrical science and linked firmly its principles to those of chemistry and physics To him may be ascribed much of the development which made possible the submarine cable (*see* Cables)

Maxwell and the Electromagnetic Theory

James Clerk Maxwell (1831 1879) rejected the idea that electricity exerted a 'pull' across empty space Electric stresses and strains according to his theory produce wave motions in the ether of space, and he was thus led to investigations which pointed the way for wireless telegraphy and telephony Maxwell showed that electric phenomena display mathematical relations corresponding to the phenomena of light and he inferred that light heat and electric waves *are of much the same nature* (*see* Radiation)

Heinrich Rudolf Hertz (1857-1894) professor of physics in Karlsruhe, Germany, became interested in Maxwell s theories and succeeded in producing electromagnetic waves, later called Hertzian, or radio, waves He demonstrated that these waves, like light waves, are transverse They can be reflected, refracted, and polarized He measured the wave length of these electromagnetic radiations and found them to be less than a meter. Hertz's contribution paved the way for the practical development of radio, started by Guglielmo Marconi (1874-1937), and *continued* by a host of investigators and inventors (*see* Radio).

Growth of Electron Theory

Many of these men have contributed to the electron theory Faraday s theories contained a hint of it, Maxwell used the phrase "a molecule of electricity", George Johnstone Stoney called the as yet undiscovered ultimate unit of electricity an electron " It was Sir J J Thomson (1856-1940), professor of experimental physics at Cambridge, who measured the mass and determined the electric charge of the particles in cathode rays (*see* Electrons and Electronics, X-Rays), and identified them with the ultimate particles of electricity now known as electrons.

The contributions of some men have earned for them the popular title of ' wizards," men such as Alexander Graham Bell who invented the telephone Thomas Alva Edison who invented the electric light, Nikola Tesla who devised the alternating-current *induction electric motor*, and *William Roentgen*, the discoverer of X rays

There are many others less widely known, who have been responsible for the invention and development of the electric street-car, the wireless telephone, turbo-dynamos, electrochemical methods—a few of the inventions of the mighty host of diligent workers who have given the world gifts of untold value

HARNESSING ELECTRONS *to Get* POWER, LIGHT, *and* HEAT

ELECTRIC LIGHT AND POWER When a city is cut off from electric power for any length of time, a state of emergency exists Police and fire protection are hampered by unlighted streets Reservoir water cannot be purified and refrigerated food begins to rot Office buildings, mills, and factories must close down, and hospitals are seriously affected Patients kept alive by electric equipment might die before independent batteries are put to work

The list of tasks done by electric current is almost endless In the United States more than 85 million tons of coal are used each year to generate current Almost 47 million barrels of oil about 358 billion cubic feet of gas, and huge quantities of falling water are also required

Electricity is actually a flow of electrons, and there are different ways to measure this flow A *volt* is the expression of its intensity or pressure An *ampere measures the amount of* current An *ohm indicates* the resistance offered by the wire that carries the current The amount of electric power consumed by a lamp is expressed in *watts* (volts times amperes) A *kilowatt* is 1 000 watts The unit of measurement for the amount of work done by electricity is a *kilowatt-hour*, or 1 000 watts of power used over a period of one hour

To most people light seems to be the most important use of electric current, since it affects them so directly More than 90 per cent of the homes in the United States are now electrically lighted, and current is available to still more Almost every daylight activity is possible on the darkest night, thanks to electric light

The Carbon Arc Light

Electricity was little used as a source of light until late in the 19th century The first electric light was an *arc* lamp This was invented by Sir Humphry Davy as early as 1801 but his lamp was not practical for commercial use It was not until 1878 that C F Brush perfected an efficient arc lamp Within a few years Brush lamps were being used to light streets and factories

In the carbon arc lamp there are two sticks, or *electrodes*, of hard carbon through which the current flows These conductors are in contact when the current is turned on Then they are pulled apart and a *brilliant white flame, or arc,* forms between them Most of the light, however, comes from the incandescent tips of the carbon

Still among the most brilliant of artificial lights, these lamps make excellent military searchlights The motion picture industry uses them for lighting studios and projecting film on screens Doctors use the ultraviolet rays these lamps generate Their high temperature makes arcs impractical for small lamps for they need constant adjustment and replacing

The Cooper-Hewitt mercury arc lamp, based upon the principle that an electric current passing through mercury vapor inclosed in a vacuum tube produces a brilliant glow with no red rays, was brought out in 1901. This lamp was admirably suited to photography and to the lighting of printing plants, and other places where glare would be trying on the workers' eyes. It has never been found practical for general illumination as it produces unnatural color effects, and has a delicate and costly structure. Aside from its light-giving qualities, the mercury-vapor arc is the most powerful source of ultra-violet rays, provided it is inclosed in a fused quartz tube instead of the ordinary glass, through which the rays cannot pass.

Between 1878 and 1880 Thomas A. Edison and Joseph W. Swan perfected practical incandescent lamps. Edison's main problem was the finding of a suitable *filament*, or substance fine enough to heat up and glow with a current of moderate power. It had to stand a high temperature without melting; and it had to be rugged enough to endure mechanical shocks. After long experiment he produced a suitable filament by carbonizing cotton thread, for which he later substituted carbonized bamboo fiber.

Imprisoned in a Vacuum

This filament had to be inclosed in a vacuum, for it would have burned up in the presence of air. So Edison designed an all-glass bulb with a small projecting tube. After the air had been pumped out through it, this tube was melted shut. The two wires fastened to the carbon filament passed through air-tight seals in the base of the bulb. These had to be made of a metal which, when heated, expanded the same amount as the glass. Otherwise, when the whole bulb became hot the seals would break. Platinum was at the time found to be the only metal suitable for this purpose.

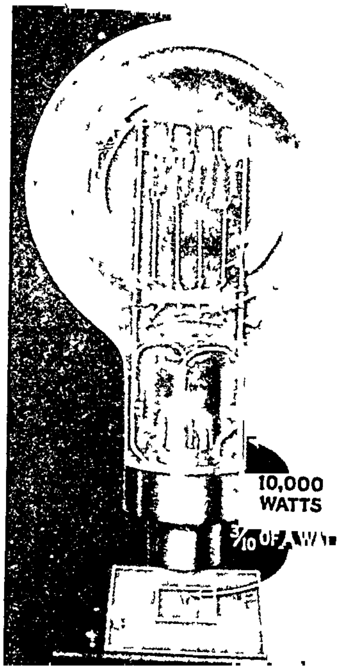
The carbon filament had one disadvantage. It fell apart rapidly when heated by a current to the white glow required for maximum lighting efficiency. For this reason, the old carbon lamps could give only a yellowish illumination. Various metals of greater chemical stability and high melting points, such as osmium and tantalum, were tried out in its place.

Development of the Modern Lamp

At length in 1910 the modern filament of drawn tungsten wire was evolved (*see* Tungsten). In a vacuum bulb, even the tungsten filament tends to evaporate at high temperatures, throwing off particles and thinning itself down until it "burns out," meanwhile blackening the inside of the glass. To minimize this trouble, gas-filled lamps were devised in 1913. Inert gases, such as argon or nitrogen, or a mixture of the two, which will not attack the tungsten chemically even when the latter is white hot, are sucked into the bulb after the air has been pumped out. The pressure of this gas partially prevents the tungsten particles from leaving the filament, thus allowing it to be raised to a hotter, brighter glow.

In virtually all the present vacuum-type (Mazda B) lamps as well as in the gas-filled (Mazda C) lamps, the filament is wound into a very fine spiral, and mounted in this compact form to better maintain its heat. The fine metal brackets that support the filament in the vacuum lamps are made of tungsten, in the gas-filled lamps of molybdenum, which has almost as high a melting point as tungsten and better mechanical properties. The sections of the lead-in wires, which carry the current to the filament supports, are no longer made of expensive platinum, but of a copper-plated nickel alloy that matches exactly the heat expansion of glass. The base of the lamp is made of brass to which the lead-in wires are soldered or welded.

THE GIANT AND THE MIDGET



Here are the two extremes in the great family of standard electric lamps in common use today. Above is the powerful lamp employed in floodlighting airports and moving-picture studios; below, too tiny to show well on the same scale, is the sinuscope lamp, which is so small that physicians can get it into the cavities connected with the nose.

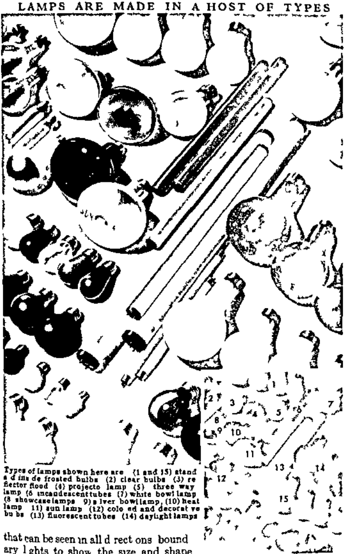
One of the latest major lighting improvements was the introduction in 1925 of the inside-frosted lamp. It diffuses the light with little loss from internal reflections and permits a standardized method of manufacture which has greatly lowered the cost of lamps.

An Amazing Mechanical Feat

The manufacture of the standard household lamps is one of the triumphs of automatic machinery. There is, for example, a single mechanism into which bulbs, tubes, rods, filament wire, support wire, bases, and packing material are fed. Out of it come finished lamps, exhausted or air-sealed, marked, tested, wrapped, and packed in a case ready for shipment.

A tremendous variety of other lamps is produced. They range from the huge beacon lights used at airports, to the tiny bulbs on the end of the physician's gastroscope or sinuscope, with which he can look down a patient's throat into his stomach or explore the sinuses of the head. A powerful beacon of more than 2,000,000,000 candle power lights the sky of Chicago guiding aviators in their flights over the city. At airports there are whole batteries of powerful lights —rotating beacons of several million candle power

LAMPS ARE MADE IN A HOST OF TYPES



Types of lamps shown here are (1 and 15) stand a d ins de frosted bulbs (2) clear bulbs (3) re flector flood (4) projecto lamp (5) three way lamp (6 incandescent tubes (7) white bowl lamp (8 showcase lamps 9) s lver bowl lamp, (10) heat lamp 11) sun lamp (12) colo ed and decorat ve bu bs (13) fluorescent tubes (14) daylight lamps

that can be seen in all d rect ons bound ary l ghts to show the size and shape of the field green lights to ind cate the best approaches red l ghts to mark obstruct ons and floodlights to illuminate the field Floodl ghts are also used for nighttime sports events and at sites where construction work must be done at night They are even used to illum nate the outside walls of skyscrapers for decorative effect

Lamps by the Billion

The Un ted States leads the world in the manufac ture of electric-light bulbs Its factories turn out nearly 2 b llion lamps every year More than 600 mill on of these lamps are intended for general il luminat on (15 to 150 watts) and nearly 400 million are Christmas-tree bulbs Large wattage lamps of various kinds account for about 250 mill on of the total product on and automobile lamps for nearly the same amount Flashlight bulbs and similar types number more than 200 mill on and photographers flash bulbs come close to the same figure

The United States exports about 4 per cent of its total production of electric lamps The next big producer is the Un ted Kingdom Its output is about one-fifth that of the United States

Advances in Lighting

Engineers have developed many types of bulbs besides the incan descent One of the most efficient is the *vapor* lamp which operates with ionized vapor or gas (*see* Ions) Filled w th sodium vapor these lamps provide inexpensive l ght for highways Mercury vapor is even more useful It lights highways factories televis on studios and canals and locks Its intense light hastens chem ical action and so it is used to prevent wool shrinkage and to make flowers grow at n ght The torch of the Statue of Liberty is lighted by mercury vapor lamps

Lamps filled with rare gases such as neon and krypton provide air port fog lights and advertising il lumination Some of these tubes are coated inside with material which fluoresces when struck by ultraviolet rays from the glowing vapor in the tube (*see* Light) Fluorescent lamps furnish what is called cold light They g ve one-fourth the heat and provide several times the light of filament lamps using equal power Since the light comes from a long tube as pictured on this page it is soft and free from glare

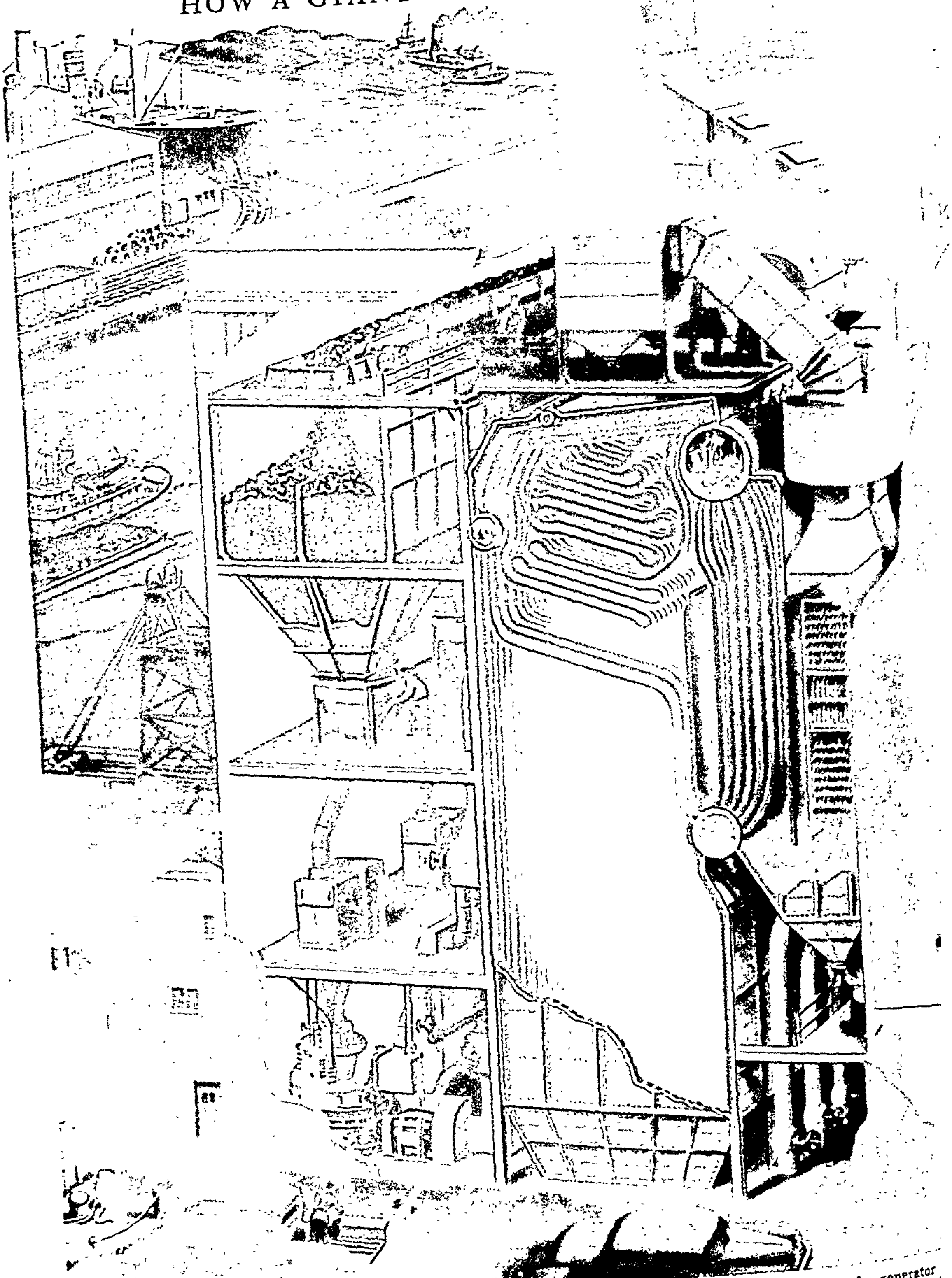
Engineers and scientists have learned to improve illumination and to protect eyesight by *indirect* lighting They have des gned bulbs and reflectors wh ch diffuse l ght by direct ng it first against walls and ceilings This breaks up direct rays and does much to prevent harmful and disagreeable glare (*see* Lighting)

Electric Power Production

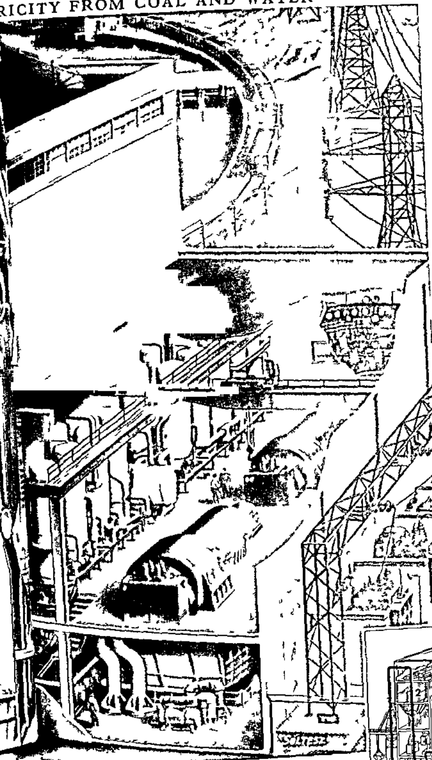
There were only 59 consumers of electric power in 1882 when Edison established the first central gen erat ng system of the United States in New York City Today more than 40 mill on Americans buy electric power To meet this demand 4 000 central power plants throughout the co intry can generate more than 60 million kilowatts at one t me In an average year they produce more than 300 billion k lo vatt-hours

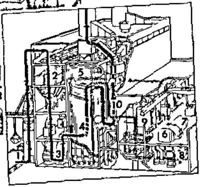
These plants are operated by private companies by cit es or by the Federal government Steam engines

HOW A GIANT POWER STATION MAKES ELECTRICITY



Steps in generating electricity are indicated by numbers in the small diagram at right. Coal (1) is hoisted to a hopper (2) and dropped through a pulverizer (3). Then hot air blows it into the boiler (4). Heat makes steam in water tubes (5), and the steam drives a turbine (6). This turns the generator which produces electricity. Most of the used steam is cool to water in a condenser (8) and piped back to the boiler. But some passes through a heater (9) to preheat fresh boiler





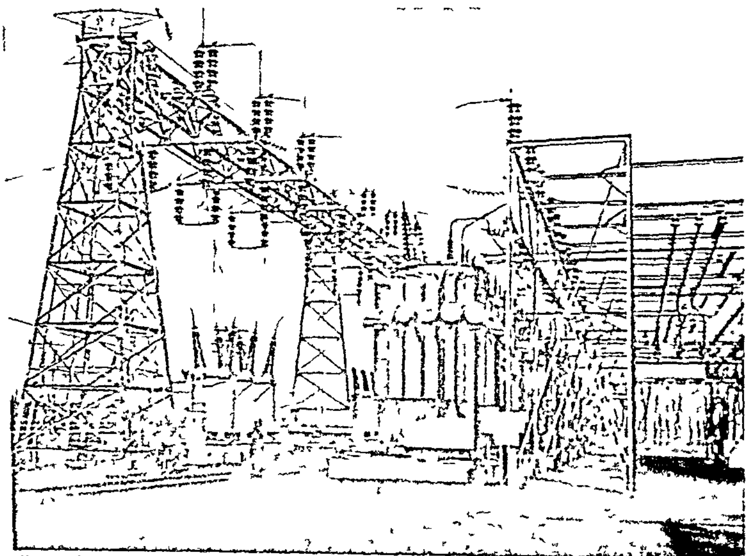
COAL
GASES
WATER
STEAM

...ter Exhaust gases pass through an economizer (10) which ...o heats bo ler water and then through a heater (11) to ...rm a r for the boiler fire (*This pictu e was prepa ed by the ...rmst ong Cork Company and the Edison Electric Institute*)

or turbines, Diesel engines, or water turbines are used to drive the generators in these plants Coal or oil is used in steam units, and light oil in Diesel plants. Not all electric power is generated at central stations, however Generators, run by various means, supply electricity to automobiles, trains, and ships Storage batteries are often used in connection with these portable units

Where falling water is available, central plants use hydroelectric power These plants account for perhaps one-third of the nation's current (*see* Water Power) Regardless of the source of power, however, all plants use the same methods of transmission and distribution.

A HUGE "PUMPING STATION" FOR ELECTRIC POWER



Those giant transformers in the center act like pumps in a water supply. They "step up" the pressure of the current to 132,000 volts so that it can be sent on long journeys over thin wires. The wires are carried across country on those steel towers. Note the big insulators that hold the wires away from the steel framework. An oil circuit breaker (switch) stands at the left. This station is situated near Chicago, Ill.

In most of these stations generators produce alternating current at 2,000 to 14,000 volts. To send this over a great distance, *step-up transformers* raise it to from 66,000 to 220,000 volts or more. Current at high voltages can be sent over fine wires that offer little resistance. Thus less power is lost through heat. These wires run across country in cables supported on high steel towers.

As the current nears its destination it flows into a *substation*. There it is first reduced to 22,000 volts for industrial consumers, then to 4,000 or 2,300 volts for transmission through city wires. A small *step-down transformer* attached to a pole or underground conduit cuts the current further before it enters a dwelling. Voltages for household use are 110 and 220, 115 and 230, or 120 and 240. When direct instead of alternating current is required, a *rectifier* in a near-by substation makes the change.

As the wires enter a home they pass through a *watt-hour meter*, which measures the amount of energy used. This can be read in kilowatts from four clocklike dials on the face of the meter. The wires may then travel to a main distribution center. Several circuits branch out from this for ordinary use, and there are usually additional circuits to supply high-wattage appliances. Where a water heater or range requires 220-volt current, a special circuit is used. Either *fuses* or *magnetic circuit breakers* guard the circuits from overloading. Without this protection, wires could become hot enough to start a fire. In some modern installations several small distribution panels are used instead of one central panel. Each panel then serves one separate section of the house.

Handling "Peak Loads"

Electric plants must solve the problem of the "peak load," or maximum demand for current, in the localities they serve. For example, Wilmington, Del, is an industrial center that needs maximum power in daylight hours; Atlantic City, N. J., a resort, has a peak load at night Before long-distance transmission of power became practical, each city needed enough equipment to supply the peak hours. Today "superpower chains" enable these stations to serve Wilmington by day and Atlantic City after dark.

The chain of plants in and around New York City represents the greatest concentration of electric power in the world. If one unit breaks down, others immediately take up the load. During the first World War, before they were interlocked in this way, the system once broke down completely. The roar of an explosion in a munitions plant woke thousands of people They all switched on their lights at the same time and overloaded the system.

There are now many other precautions against overloading. For example, automatic detectors announce the approach of storms that may darken a city and create a demand for more power.

How Industry Uses Electricity

Electricity gradually caused a new industrial revolution. When electrical devices could be substituted for the steam engine in the factory, far more efficient production became possible. Vastly different machines could be combined into one single operation, continuous and automatically controlled. This produced a uniform quality of materials and made mass production possible. Working conditions also improved as standards of production rose.

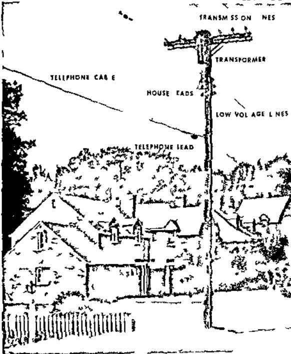
Factories that had used central steam engines for power were crisscrossed by a maze of wasteful and dangerous moving parts. These included line shafts, countershafts, pulleys, and belts at every turn. All this

was replaced by separate motors on the various machines. The separate motors could be regulated as desired, whereas a central steam engine could run only at its own rate or rates. Electrically powered machinery also was faster, smoother and more economical for every kind of operation. Whether it is as large as a room or as small as a thimble, the electric motor has only one moving part. It converts 90 per cent of the energy supplied to it into useful mechanical work. It is cheap to make and simple to maintain. Motors can be built for a range of work from drilling a microscopic hole to lifting a giant locomotive (*see* Electric Generator and Motor).

Electricity makes possible the manufacture of certain metals and alloys. The steel industry uses it in every essential operation, from digging ore to welding sheets. There would be no aluminum pots and pans or airplanes without it, because electricity offers the only practical means to separate aluminum from its ores. Electric arc furnaces provide extremely high and uniform temperatures. Electric power makes possible precise stamping, cutting and fitting. It is impossible to list all the industrial uses of electricity.

The domestic uses are also numerous. Besides providing light for work and play, electricity makes possible the use of ultraviolet lamps to kill bacteria and infrared lamps for radiant heat. It provides heat for ranges, water heaters, irons, toasters, electric blankets and so on. It runs motors for refrigerators, fans, washers, razors and a host of other devices. Such uses testify to the labor and timesaving aspects of electricity.

HOW ELECTRIC POWER ENTERS A HOUSE



Current at high voltage from a substation is stepped down by a pole transformer before it enters a house. In many cities power transmission poles also carry telephone cables and leads

Rural Electrification

The Federal government has organized an agency to secure the benefits of cheap electricity for people in rural areas. In 1935 the Rural Electrification Administration began to extend long term loans for power-line construction and for the wiring of farm buildings. At that time 11 per cent of the farms in the United States were electrified. Today about 90 per cent buy power from federal or private companies. This costs a farmer one-fifth of what maintenance of a

TWO WAYS ELECTRIC POWER IS DISTRIBUTED INSIDE A HOUSE

In most houses all current passes through an entrance panel (left) in the basement. The panel has the main switch and fuses or circuit breakers for all circuits in the house. In other dwellings small decentralized panels (right) handle circuits for particular rooms

gasoline or windmill generator would require. Electricity can perform more than 200 different jobs on a farm. It can pump water, grind feed, hoist and dry hay, pasteurize milk and keep it cool, and keep chicks and baby pigs warm. It can increase milk production by furnishing cows with warm water in the winter and by operating milking machines. When rural areas progress in this way, the whole country becomes more prosperous.

Federal Power Plants

Eighteen per cent of the power used in rural areas comes from the Rural Electrification Administration and other government agencies. Power plants owned by the Federal government generate about 35 billion kilowatt-hours of electricity yearly. They can produce more than 5 million kilowatts at a time. New machinery will raise the capacity of these plants to an ultimate 8 million kilowatts.

Hydroelectric plants became especially important during the second World War. War industries grew up around them to take advantage of their high, constant output of electric current. The Bonneville and Grand Coulee plants on the Columbia River supplied power for the giant atomic-energy plant at Hanford, Wash. They also furnished the power for plants on the west coast that produced one-third of the nation's war output of aluminum. Similarly, the Tennessee Valley Authority supplied the famous atomic-energy plant at Oak Ridge, Tenn.

The Tennessee Valley Authority is a separate federal corporation. It operates directly under congressional supervision (*see* Tennessee Valley Authority). The Department of the Interior, however, supervises most of the federal plants through its Division of Power. These plants sell their current through various local *administrations*. The Bonneville Power Administration, for example, sends power over a network of high-voltage transmission lines to Oregon, Washington, and Idaho. The Southwestern Power Administration includes hydroelectric plants on several rivers in the Southwest. This administration serves Arkansas, Louisiana, and parts of Kansas, Missouri, Texas, and Oklahoma.

The Bureau of Reclamation in the Department of the Interior coöperated with the United States Army Corps of Engineers in planning and building these plants. Their work also includes flood control, irrigation, and reclaiming eroded farm lands in the areas where the plants are located.

ELECTRIC SIGNS. At night, New York City's world-famous "Great White Way" is lighted as bright as day by nearly 4,000 large electric signs. In less than a third of a square mile, along Broadway from 34th to 59th streets, as well as on the side streets, more than half a million lamps flash on nightly in the signs. They make this locality the most vividly illuminated area on earth.

Almost every large city in the world has its own "white way." On the sides or roofs of buildings along such a street, glowing letters, shifting slogans, and animated figures urge in many colors the merits of an automobile, a tooth paste, an entertainment feature, a food product, or a restaurant.

Huge Sums Spent for Signs

At first, theaters and other places of amusement were the greatest users of electric signs. If an actor got his name "in the lights" he considered himself famous. But today, mercantile signs outshine the theater announcements. Companies spend millions of dollars for this kind of advertising. One company spent more than a million and a half a year for several years for its New York signs alone. At one time the largest sign in the world stood on the roof of a four-story building near Times Square in New York City. The advertiser paid nearly a hundred thousand dollars a year for the use of the roof. The sign was 200 feet long and more than 50 feet high. It contained 19,000 lamps.

The first large electric sign was built in 1895 at the corner of Fifth Avenue and 23d Street. It flashed the news "Manhattan Beach Swept by Ocean Breezes." Many of these early signs burned continuously during the first hours of the night. Others flashed on and off at regular intervals to gain greater attention. Today, in many signs, letters and words can be changed at will. Animated pictures appear; colors and brightness change. In some newspaper and moving-picture theater signs, a continuous stream of words seems to flow arround a building, telling the news of the day or advertising a picture.

To obtain these effects, the lamps on the face of the sign are connected in many separate patterns and circuits. Each circuit can be turned on and off at the proper instant by automatic switches. For example, any letter of the alphabet can be formed in a space four feet square with some 500 small 10-watt lamps, ingeniously connected together into 26 different circuits.

Electric signs have been carried over large cities by blimps. The blimps generate the electricity for the signs, some of which have 10,000 lamps. The signs may be seen for five miles.

How Neon Signs Are Made

Today many signs use neon tubes instead of electric light bulbs. The tubes are emptied of air and then supplied with small quantities of various gases. The gases are set glowing by the passage of a high-voltage current. The tubes are bent into the shapes of the desired letters or ornaments.

Signs of this type are called "neon" because the first ones contained neon gas. This produces a penetrating red light which can be seen in broad daylight or through heavy mist. Other gases give other colors. Mercury vapor gives blue; helium in an amber tube gives a golden glow; green is obtained with a blue glow in a yellow tube. When several gases are used in a tube, the resulting colors combine to give white (*see* Color). Similar effects are obtained by adding fluorescent material to the tubes and exciting it with radiation from mercury vapor (*see* Electric Light and Power).

ELECTROCHEMISTRY. All of chemistry is closely related to electricity, but the name electrochemistry is by custom reserved for the science dealing with chemical reactions that produce, or are produced by, electric currents. In this field the phenomenon called *ionization* rules supreme.

Ions are atoms or molecules that have lost or gained electrons and in that condition take part more or less independently in chemical or electrical activity. Those that have lost electrons are positively charged (*cations*); those that have gained electrons are negatively charged (*anions*).

Ionization occurs to a limited extent in all liquids, but is sufficient for practical purposes only in solutions of *acids*, *bases*, and *salts*. It is largely because these three types of compounds always *dissociate* into ions when they go into solution that they are so active chemically. They are often called *ionogens*, that is, "ion generators." The mechanism of dissociation is explained in the articles on Acids and Alkalies; Chemistry; and Electricity.

An acid may be defined as any substance which in solution has *hydrogen* for its positive ions. A base is any substance which yields *hydroxyl* (OH) for its negative ions. A salt is any substance which yields positive ions *other than hydrogen* and negative ions *other than hydroxyl*.

The Effect of a Current on a Solution

When an electric current passes through a solution it is transmitted by the ions, and the result is always a *decomposition* of the dissolved substance. For example, in a solution of hydrochloric acid (HCl), the positive hydrogen ions travel to the negative electrode, where they acquire electrons to replace those lost in dissociation. This turns them into plain hydrogen atoms which bubble away. The negative chlorine ions, on the other hand, seek the positive electrode where they give up their surplus electrons, become plain chlorine atoms, and also bubble away.

This permanent break up by an electric current of an already dissociated compound is called *electrolysis*. If the products of the decomposition are solids, they may deposit themselves on the electrodes or fall to the bottom as precipitates. With electrodes made of metals or other substances that will themselves dissolve in the solution, many useful chemical substitutions and transfers can be achieved, as in electroplating and similar processes.

The Production of a Current by a Solution

The converse of electrolysis—namely the generation of current by a chemical solution in an "electric cell"—requires, as explained in the article on Electricity, a twofold chemical action in which the conductors or terminals that dip into the solution must play a part. The action is like an ordinary chemical *displacement* (a second group of positive ions throws *out of* solution the group that was in the solution first), except that it takes place at long range through the medium of the wire and whatever apparatus is being operated by the current from the cell. The first half of the displacement takes place at the *negative* terminal. Atoms of the metal composing this terminal abandon some of their electrons and go into solution as positive ions. The abandoned electrons pass around the outside circuit to the *positive terminal*. There they attract, meet, and attach themselves to members of the first group of positive ions, turning them into neutral atoms which throws them out of solution and completes the second half of the chemical displacement.

How Metals Differ in Activity

The fact that one group of positive ions can replace another in this fashion is one of the most important facts of chemistry.

In the accompanying list the common metals and hydrogen (which behaves in this case like a metal) are arranged in the order of their readiness to part with electrons. Lithium loses electrons more easily than potassium, for instance, potassium more easily than sodium, and so on.

The list is variously called the "activity series," the "displacement series," and the "electromotive series."

Lithium
Potassium
Sodium
Barium
Calcium
Magnesium
Aluminum
Manganese
Zinc
Chromium
Cadmium
Iron
Cobalt
Nickel
Tin
Lead
Hydrogen
Copper
Arsenic
Bismuth
Antimony
Mercury
Silver
Palladium
Platinum
Gold

Because of its greater tendency to let go of electrons each metal bears the following relations to any metal below it in the list: it is more active chemically; it oxidizes more easily and hence is less likely to be found free in nature (the metals above hydrogen are virtually never found free—those below hydrogen are frequently so found); and *it will displace the lower metal from ionic solution*.

Thus zinc will displace copper from a solution of copper sulphate, precipitating metallic copper, and so will iron, but silver will not displace the copper. If iron has displaced the copper in the solution and then zinc is added, the latter will in turn displace the iron. If pairs of metals are used for the terminals of a cell, the metal higher in the list will always be the negative terminal, and the farther apart the metals are in the list, the greater will be the voltage of the cell. On the other hand, in the electrolysis of solutions of metallic salts, the higher the metal stands in the list the higher will be the voltage (electromotive force) required to push it out of solution and deposit it on the cathode.

Ionization of Gases

Gas atoms may become ionized as the result of collisions among themselves or because heat, light, ultra-violet rays, X rays, or other forms of radiation temporarily drive electrons out of the atoms.

Whatever the cause of ionization in a gas, it makes the gas a conductor of electricity in precisely the same manner as do ions in a liquid. A charged electroscope will be discharged when the air around it is ionized. This provides an important method for detecting and measuring the intensity of various types of radiation. Cosmic rays were discovered by observing the slow discharge of an electroscope which was shielded from all other known forms of radiation.

Ionization does not play such an important part in the chemistry of gases as it does in that of liquids. The chief practical application of the electrical conductivity of gases is found in mercury vapor and "neon" lights, and various types of rectifying tubes and glow-lamps (*see* Electrons and Electronics).

ELECTROLYSIS. Whenever an electric current is transmitted through a liquid, some or all of the compounds that compose the liquid are decomposed into simpler substances. This process is called *electrolysis*, from Greek words meaning "electric loosening." It can take place only in liquids which contain other substances in solution, so that positive and negative ions are formed (*see* Chemistry; Electricity; Electrochemistry).

Certain metals are produced by this process, as in the electrolysis of fused, dry caustic soda into the metallic sodium. Many metals, such as gold, silver, aluminum, copper, zinc, and nickel, are reduced and refined by electrolytic processes. Electroplating and electrotyping are adaptations of the process.

The term electrolysis is often employed to describe the erosion of gas and water mains in the ground due to stray currents from streetcar lines.

ELECTRONS *and Their* USES *in* ELECTRONICS

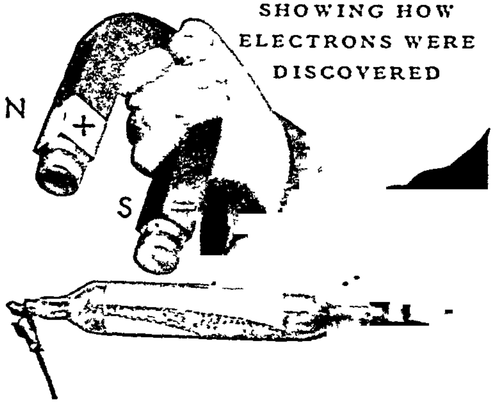
ELECTRONS and ELECTRONICS. Before 1897, the atoms of chemical elements were thought to be the smallest particles of matter in the universe. But in that year, Sir J. J. Thomson announced the discovery of something much smaller in the glowing interior of a Crookes tube. This device was a glass tube with metal electrodes. Reduced gas pressure in the tube enabled electricity to pass and create a glow.

Usually discharges passed as a narrow beam down the center of the tube. But if a magnetic field was applied, the beam was deflected. When the field was reversed, so was the deflection. This could only mean that the beam contained moving particles. This kind of change showed that the particles carried a negative (—) charge of electricity.

Electrical Nature of Matter

Scientists called these particles *electrons*, a name suggested in 1891 by G. J. Stoney of Ireland. Careful measurements showed that an electron had only about $\frac{1}{1840}$th as much mass as a hydrogen atom. Such a mass was astoundingly small, since it takes about 17 trillion times one trillion hydrogen atoms to weigh one ounce.

SHOWING HOW ELECTRONS WERE DISCOVERED



This demonstration uses a Crookes tube with a card set along the middle and coated with a chemical that glows when hit by electrons. In a darkened room the electron stream shows plainly along the card. If a strong magnet is brought near, the beam is deflected as shown by dotted lines. This proves that electrons are negatively charged particles of matter.

The discovery also upset all previous ideas about matter. Atoms were no longer the smallest particles in the universe. At about this time radioactive elements were discovered and found to be emitting both electrons and positively charged (+) particles (*see* Radioactivity). This discovery, in addition to those made by Thomson and others, led scientists to believe that all atoms (and therefore all matter) must be made up of charged (+) and (—) particles (*see* Atoms).

In each atom the positively charged particles are arranged in a central clump called the *nucleus*. An equal number of electrons moves in orbits around the nucleus. The equal number of positive and negative charges makes the atom as a whole electrically neutral. Speedy movement of the electrons in their orbits keeps them from uniting with the nucleus, as positive and negative charges would normally tend to do. (A well-known rule about static electricity states that unlike charges, + and —, attract each other.)

The Science of Electrons

When electrons (— particles) are organized within atoms they are called *bound* electrons. When they can move by themselves outside atoms they are called *free* electrons. Once scientists understood these facts, they learned how to harness free electrons in many valuable devices such as radio tubes, photoelectric cells, X-ray tubes, cathode-ray oscilloscopes, and fluorescent tubes.

The study and use of free electrons in space constitute the science of *electronics*. The science deals largely with use of electrons to create and maintain electric charges and currents in various devices.

Electric Charges and Currents

Since ancient times, men have known that if amber is rubbed with fur, it will attract bits of straw and other light objects. The same is true of glass rubbed with silk; and other pairs of materials.

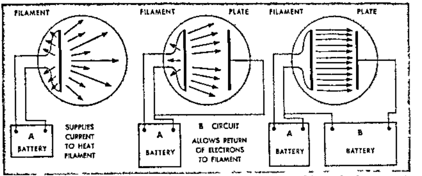
Such experiments produce electric *charges*. The rubbing detaches electrons from the atoms of one material and leaves them on the other substance. This upsets the normal electrical neutrality in the atoms of the two substances. Atoms which lose electrons have an unneutralized positive charge. The material with excess electrons has an unneutralized negative charge; and each charge exerts electrical attraction or repulsion upon material near by. (Just as unlike charges attract each other, so do *like* charges repel each other. *Like* charges are + and + or — and —.)

Devices such as electric batteries and generators can also maintain a *difference* in charge between two locations. Any of these devices can keep stripping free electrons out of one location, leaving positive (+) charge, and drive them elsewhere, piling up negative (—) charge. If the two localities are connected outside the generating device with a suitable

pathway, the electrons will flow continually through the pathway toward the unneutralized positive charge (*See also* Electricity) Such a flow constitutes an electric *current* The pathway must be made of material (called a *conductor*) which transmits free electrons readily The metals, especially copper, are the most commonly used conductors

Discovery of the electronic nature of electric current upset several older rules Previously scientists had assumed that current flows from positive to negative, and many rules had been based upon this assumption Scientists and engineers still use these rules in many discussions about electricity But discussions of electron movements must recognize that electrons flow from negative to positive It is this flow of electrons which constitutes an electric current

USING ELECTRONS IN A DIODE



Here a heated filament gives off electrons in a vacuum tube Current to heat the filament is supplied by an A battery as shown, but another source of current can be used as well. In response to the heating, electrons fly off the filament in all directions Loss of the electrons leaves the filament with a slight + charge.

Now a plate has been inserted in the tube and connected with the filament through an outside B) circuit Some electrons strike the plate and immediately start through the circuit to rejoin the + charge on the filament This flow of electrons through the tube and the B circuit constitutes a current The current will flow as long as the filament remains heated and the heat drives off electrons to the plate

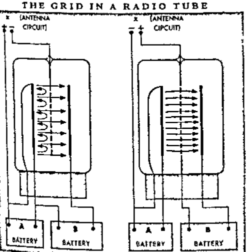
Here a B battery has been connected to supply charges as shown to the filament and the plate The battery places a — charge on the filament and a + charge on the plate The two charges drive and draw all the electrons across the gap as fast as heat drives them out. Meanwhile the battery by chemical action transfers the electrons through the circuit from the plate to the filament This tube is called a diode

Development of the Radio Tube

The working principles of electronic devices can be understood easily from the history of the radio tube In 1883 Thomas Edison found that the heated filament of an incandescent lamp gave off electrified particles This phenomenon is called the "Edison effect"

Edison did not develop his discovery In 1904, however, J A Fleming of England used it to produce the Fleming valve (now called a *diode*) He produced the Edison effect by heating a filament in a vacuum tube Then he used the electrons to carry current from another circuit across the gap in the tube

THE GRID IN A RADIO TUBE



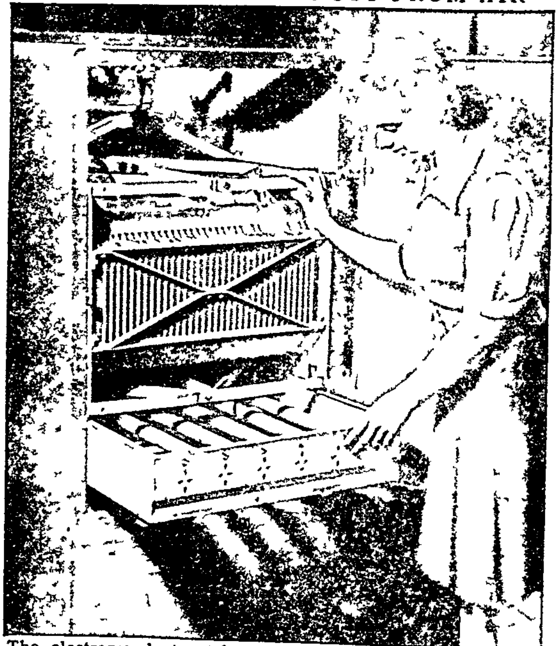
Here De Forest's grid has been placed in a diode, making a *triode* The grid and filament are connected at X to some source of varying voltage such as a radio antenna circuit. If the voltage is such as to place — charge on the grid and + on the filament (left) some electrons are driven back from the grid and the current across the gap is lessened If the grid and filament charges are reversed (right), more electrons are drawn across the gap and the current is increased Thus the triode reflects the most minute voltage changes in the circuit X

This device could be used as a radio detector When weak signal currents were used to heat the filament, they released stronger (amplified) current in the second circuit Today the diode is used largely to *rectify* alternating current (A C) into direct current (D C) The alternating current is divided between two circuits One circuit heats the filament The other circuit is connected across the gap in the diode In this circuit, current will flow only one way, from filament to plate

In 1906 Lee De Forest transformed the Fleming valve into a device which he called an *audion* (Today it is called a *triode*) He did so by inserting a *grid* of fine wire mesh between the filament and the plate of the diode If the grid and the filament are connected to an external circuit, the current across the gap will vary in exact proportion to voltage changes in the external circuit Moreover, the change will be *amplified* The current changes will be much greater than would normally be produced by the voltage charge

The grid served as an extremely sensitive device for detecting and amplifying both current and voltage changes The effect of a current change can be seen by turning up the volume control on a radio set This increases the positive charge on the grid, and instantly a stronger current crosses the gap in the tube Voltage changes can be detected and amplified by applying them to the grid and the filament (For hookups, *see* Radio)

ELECTRONS CLEAR DUST FROM AIR



The electronic dust catcher is designed for air-conditioning systems. First, the air passes between highly charged wires seen in the drawer, which has been pulled open for inspection. There the dust particles are ionized, or charged. Then the air passes upward between a set of charged plates which attract and hold the charged particles.

Since the tube uses free electrons only and has no mechanical moving parts, it responds, within a few millionths of a second (*microseconds*) to any change. It can be made sensitive to changes of less than a millionth of a volt or ampere. These can be amplified by using a series of tubes to any amount desired.

Many Kinds of Cathode-Ray Tubes

In many devices, a beam of electrons is the principal working element. Before electrons were discovered, such a beam was called a *cathode ray* and tubes which used them were called *cathode-ray tubes*. The term "cathode" means an electrode which emits negative (—) charge. The opposite term "anode" means an electrode with positive charge. The electron beam moves from cathode to anode.

The Crookes tube is the oldest and simplest cathode-ray tube. X-rays are produced in a special type of tube by making the electron beam strike an appropriate metal target (*see* X-Rays). Some cathode-ray tubes have a "window" of material which allows the electron beam to pass outside for experimental use.

How the Oscilloscope Works

Either magnetic deflection of cathode rays or electrical attraction and repulsion is used in *cathode-ray oscilloscopes*. The working principles of an electrically operated oscilloscope are shown in pictures on the opposite page.

This device can be used to analyze any vibration which can be made to cause changes in an electric current. For example, speech and music can be transformed by a microphone into electrical pulses. The oscilloscope is used to analyze vibrations in musical instruments, metal plates, buildings, and bridges, and to test materials under stress or tension.

Photoelectric Cells and Glow Lamps

Just as metal filaments give off electrons when heated, so do many substances when struck by light. The emitted electrons can be used to produce changes in an electric current in devices called *photoelectric cells*, or, more simply, "photocells." In a photocell an electrode coated with a light-sensitive substance is used instead of a heated filament to supply electrons (*see* Photoelectric Devices).

If a tube is only partly evacuated and has many air or gas molecules left inside, it can be used as a source of light. In such a tube fast-flying molecules are continually colliding and losing or gaining electrons; that is, they have become *ionized*. Molecules that lose electrons become positive ions; those that gain electrons become negative ions.

As soon as charges are placed on the electrodes, the ions move in response to them. Positive ions move toward the cathode. Electrons with their negative charges stream toward the anode. On the way they collide with the atoms in gas molecules and excite them to the point of emitting light. This light gives the glow seen in Crookes and Geissler tubes. Streams of electrons are used to excite fluorescent and neon lights and in the "glow" lamps of television and photoelectric devices.

Control of Space Charges

Electrons tend to return to the surface they have just left. In vacuum tubes, a cloud of electrons ("space charge") tends to accumulate around the hot filament. This — charge opposes emission of more electrons and can weaken or block the tube action.

Some tubes, such as the *thyratron*, hold down space charges by keeping a moderate number of gas atoms in the tube. Many of these atoms are hit by flying electrons, and atomic electrons are knocked off. The atoms then become positively charged *ions*, and move toward the cathode. There they reduce the space charge and more electrons leave the filament.

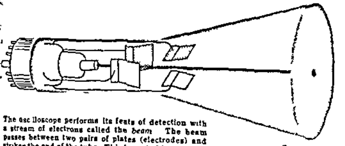
Tetrodes and Pentodes

The ordinary triode may have its efficiency reduced by space charges. Electrons often strike the plate with sufficient energy to knock other electrons loose. They may be added to the space charge. Finally, the grid and the plate tend to act as plates of a condenser (*see* Electricity; Radio). This absorbs charge and reduces the voltage which draws electrons (current) through the tube.

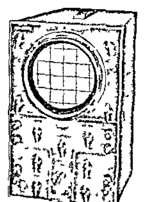
These drawbacks may be reduced by adding extra grids. A *screen grid*, carrying a somewhat smaller positive charge than the plate, may be set between the plate and triode grid. It reduces their tendency to act as a condenser. It also attracts electrons from the space charge. They pass through the wide mesh of the screen grid and on to the plate. A tube with this extra grid is called a *tetrode*.

Another grid, the *suppressor grid*, may be placed between the screen grid and plate. It is grounded

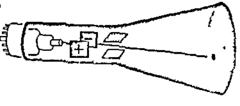
AN "ELECTRONIC DETECTIVE"—THE OSCILLOSCOPE

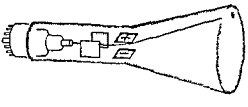


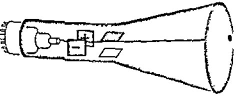
The oscilloscope performs its feats of detection with a stream of electrons called the *beam*. The beam passes between two pairs of plates (electrodes) and strikes the end of the tube. This is coated inside with fluorescent material and the electrons cause a spot of light to appear. The spot will move in response to electric charges on the plates, as shown below

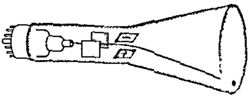


For use as a scientific instrument the oscilloscope is supplied with many electronic controls. It is mounted in a case as shown here









These pictures show how the oscilloscope responds to electric charges on the plate. Since the electrons that form the beam are negative, the beam will be bent, or deflected, toward the plate that has a positive charge (orange color) and *away from* the plate with the negative charge (blue). Thus the plates nearest the base of the tube cause sidewise movement, as shown in the two drawings at the left. The other pair of plates cause vertical movement. The fluorescent spot on the broad end of the tube (called the *screen*) shifts position accordingly. These shifts can be used, as shown below, to analyze electrical vibrations and other phenomena

1

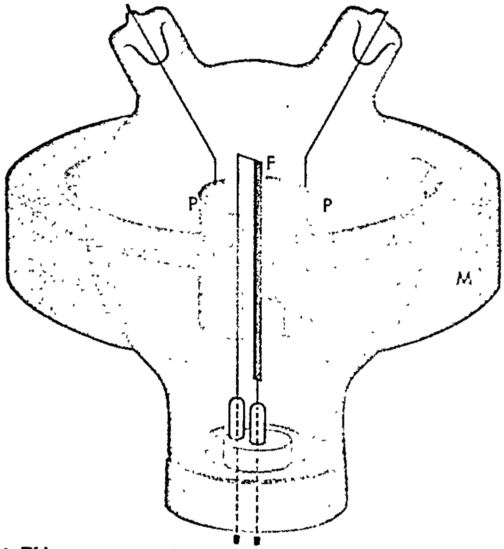
2

3

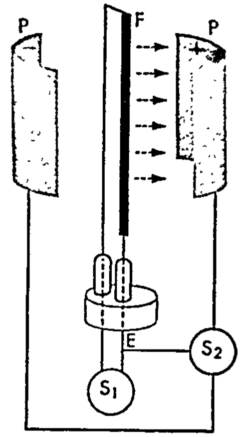
4

Here the *oscilloscope* analyzes the oscillating electric current that sends a radio message through space. To accomplish this the first pair of plates in the oscilloscope is connected to an automatic control *circuit* and the second pair to the current being analyzed. The control circuit first makes the beam take a position at one side of the *screen*. Then it reverses the charges on the plates gradually *so that* the beam sweeps from this side across the center of the screen to the other side. When the beam reaches the far side, the control circuit suddenly reverses the plate charges and the beam snaps back to the starting place. This cycle takes place over and *over again* automatically. The instrument can be set to make from one to many thousands of sweeps a second. The sweep appears on the screen as a straight, horizontal line. But now the radio current that is under inspection is connected to the second pair of plates, which control the up and-down movement of the beam. The combination of movements makes the beam trace on the screen wave patterns like the ones shown here. (1) This one is produced by the alternating current that generates a radio carrier wave; the number of up and down zigzags shows its frequency. (2) This is the pattern of a microphone current vibrating from the effect of a musical tone. (3) This is the pattern produced when the first current is modulated by the second as must be done if the sound is to be transmitted by radio. (4) This is the pattern at the receiving end after the radio signal has been detected and rectified so as to reproduce the sound in a loudspeaker; it is identical with (2) in a good set. (*See also* Radio.)

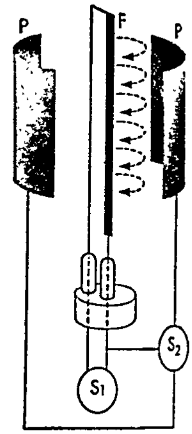
HIGH-FREQUENCY CURRENT FROM A MAGNETRON



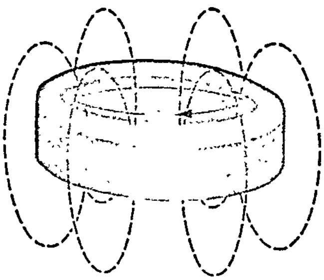
1. This magnetron (shown in simplified form) can generate extremely high-frequency current for radar and short-wave sets. It has a hot-wire filament (F) which gives off electrons, two curved plates (P, P) around the filament, and a coiled-wire magnet (M) placed around the tube.



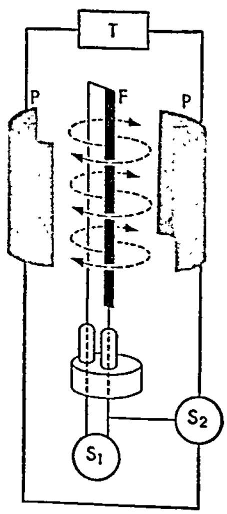
2. Here is the first step in making high-frequency current. The filament is heated by a source of direct current (S_1). A second source (S_2) gives the plates (+) and (—) charges with respect to the filament. Electrons given off by the heated filament flow to the positive plate. They return to the filament through source S_2 and the terminal E.



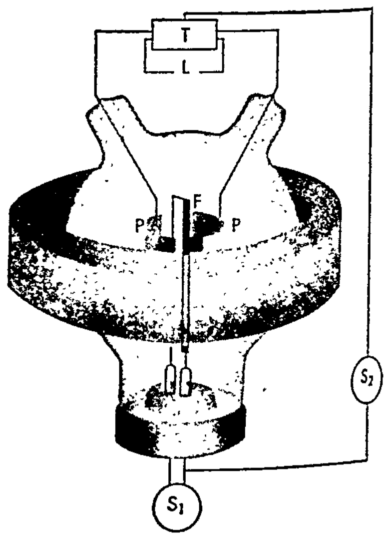
3. At a certain instant S_2 reverses its polarity, making the (+) plate (—) and the (—) plate (+). This cuts off the electron flow to the former (+) plate, since electrons are attracted only to a more positive charge. Those electrons which had started toward this plate but did not reach it will fly toward the plate with the new (+) charge.



4. Meanwhile the circular magnet is producing a magnetic field (broken lines, above). This field curves the paths which electrons follow on their way from the filament to a plate. Particularly, it curves the path of the electrons which change their course as the plate charges reverse. This curvature is shown in the picture to the right.



5. Now consider the combined effect of the magnetic field and the changing charges on the plates. If all the actions are timed correctly, electrons will start from the filament toward one plate or the other according to the charge. Then as the charges reverse, the electrons curve around to the other plate. Connected to both plates is an external circuit (T) called the *tank circuit.* Electrons striking one of the plates produce a small current through the tank circuit. As the plate charges reverse, current flows first one way, then the other, through T. These changes in direction, called *oscillations,* occur tens of billions of times each second. If nothing else happened the oscillating current would be weak. But it is strengthened as shown in the next and final step.



6. Once the magnetron is working, the oscillating current in the tank circuit supplies the reversing charges to the plates. Therefore in actual use source S_2 is connected through circuit T (instead of as previously shown) to supply electrons for movement from the filament to each plate in turn. The plates send this supply of energy to the tank circuit, thus sustaining strong oscillations. Oscillations can be drawn from the tank circuit through an antenna or some other load circuit (L) for use in radar.

and so it carries no charge. Consequently any electrons knocked from the plate return there. Addition of this grid makes the tube a *pentode.*

Tubes Used as Generators

Triodes and other tubes can be used as *oscillators* to generate high-frequency alternating current. In normal operation of a triode, a direct but varying current passes between the grid and the plate. The difference in charge ("voltage drop") between these elements varies with the current, since it depends upon the number of electrons (negative charge) which reaches the plate.

Through a suitable connection, a small part of the charge on the plate can be *fed back* to the grid, while

most of the current goes on through the B circuit The feedback causes another variation in current and voltage and builds up strong high frequency oscillations in the B-circuit current (*see* Radio)

The Magnetron Oscillator

One of the most efficient of all oscillators for extremely high frequency current is the *magnetron* The magnetron can produce tens of billions of oscillations a second In a short-wave radio or radar set these give wave lengths as short as a centimeter (about two fifths of an inch) Magnetrons can be made to produce currents having several kilowatts of power

Another type of generating tube uses *frequency modulations* This means that the tube varies the speed of electrons along a beam The varying speed is used in turn to generate oscillations as shown in the diagrams at the right This principle is used in the *klystron* and in various other types of tubes

The Transistor

Scientists of the Bell Telephone Laboratories in 1948 announced the development of the *transistor* This is a simple electronic device which performs many functions of vacuum tubes and uses only minute amounts of power A junction transistor the most useful type consists of a tiny piece of the element germanium embedded in plastic Three contact wires stick out of the plastic

Germanium is a semiconductor Its electrons are ordinarily bound so tightly in the crystal that it conducts very poorly A minute amount of certain impurities however provide it with free electrons and other impurities form positive holes in it These impurities result in types of crystals which conduct electricity in opposite directions One kind of transistor uses these qualities to form a valve similar to a rectifier tube which permits electron flow in one direction only In the junction transistor a section of germanium rich in holes may be sandwiched between two sections rich in free electrons The central section blocks current flow across it but if a varying charge is applied to a side section the effectiveness of the barrier depends upon the charge Such a transistor functions as an amplifier

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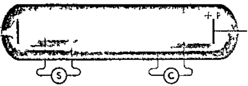
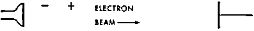
ELECTROPLATING The thin coating of gold silver nickel or chromium that is used to adorn or protect tableware watchcases automobile trim and hundreds of other articles is applied by the method known as electroplating This process is based on the principle that certain liquids are ionized when an electric current is passed through them (*see* Electricity Electrochemistry)

OSCILLATIONS FROM VELOCITY MODULATION

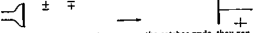


The tube above is a long diode with a filament (F) as electron source and a plate (P) Between these are two sets of grids The buncher set is supplied with alternating charges by source (S) The catcher set is connected to an external circuit (C)
To see how the charges on the buncher set generate oscillating current in circuit (C) imagine the charges as follows



The charge slows down (bunches) electrons coming from the source As they pass the grid they are speeded by the + charge Then they go in a wide y spaced stream to the plate
When the buncher grid charges are reversed the opposite effect occurs

Given proper timing of the alternating charges the buncher grids can send alternating groups of bunches and widely spaced electrons toward the catcher grids and the plate

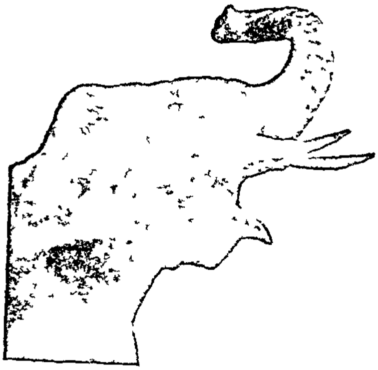


When these varying charges pass the catcher grids they generate oscillating current which passes to the external circuit (C) Part of this current can be fed back to act as source (S) Since the entire action is electronic extremely high frequency oscillations can be generated from the F P energy

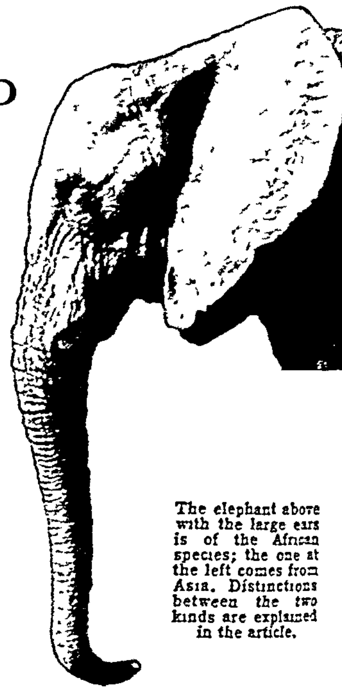
The article to be plated is cleaned and suspended in a solution of the salt of the metal which is to form the coating The article is connected to the negative terminal of a battery and a bar of the metal to be deposited is connected to the positive terminal As the current flows ionized atoms of metal from the solution are deposited on the article These atoms are replaced in the solution by others dissolved from the metal bar at the positive terminal

ELECTROTYPING The principle of electroplating is used in producing electrotypes for printing By this process copies of type pages and engravings are made in copper (sometimes nickel) to be used on the printing press A mold usually of wax or a plastic is first made of the type or engraving The mold dusted with graphite to make it a conductor of electricity is then suspended in the bath generally a solution of sulfate of copper The same process is followed as in electroplating until a thin copper plate is formed over the wax or vinylite When this plate is as thick as a heavy sheet of paper it is separated from the mold and strengthened by a backing of type metal which is melted and poured on the back of the plate Lead molds instead of wax are sometimes used for very fine work

For the most part books are printed from electrotype plates because of their durability Newspapers use stereotypes which can be made much more quickly and cheaply (*see* Stereotyping)



LONG-NOSED GIANTS *of* ASIA *and* AFRICA



The elephant above with the large ears is of the African species; the one at the left comes from Asia. Distinctions between the two kinds are explained in the article.

Character of Elephants and Their Social Life—The Story of Trunk and Tusks—The Two Great Tribes and Their Pigmy Relatives—Capturing Wild Elephants and How They Are Put to Work

ELEPHANT. The elephants are the largest living land animals. Giraffes are taller, but their bulk is much less. Adult Indian male elephants average about 4 tons in weight and 9 feet in height; the tallest reach 11 feet. African males are somewhat taller. They reach 12 feet in rare instances, though they are no heavier than the Indian species. The average height of the females of both species is about a foot less than that of the males.

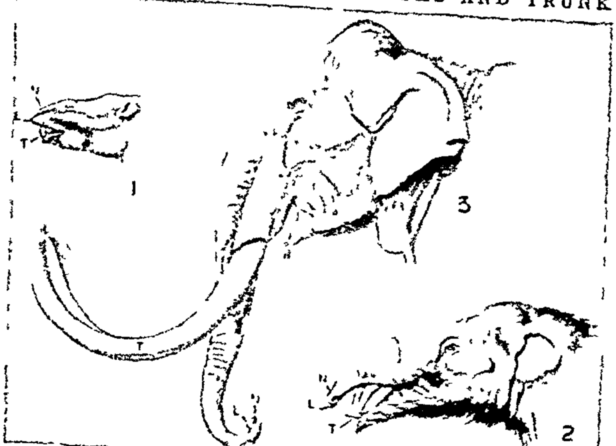
The great size of elephants and the thickness and toughness of their skins protect them from every other wild animal. Since they have no enemies to fear except man, they are generally peaceful, easy-going, and tolerant of smaller creatures.

Toward their own kind they show deep affection, and they usually spend their entire lives as members of a "family herd." This consists of several generations of blood relatives with occasional additions by mating from other herds. The typical herd contains from 20 to 40 members of all ages. Males ("bulls") and females ("cows") are about equal in number. The leader is usually an old cow. She is more likely to keep an even temper than a male, for males, peaceful though they are as a general rule, occasionally go mad during their mating periods. When a bull goes *must*, as the term is, he may in his blind frenzy try to trample down everything in the way. If he creates too much disturbance, his relatives drive him out of the herd. Usually he recovers and returns; but sometimes he becomes a solitary "rogue elephant"—one of those dangerous outcasts of elephant society which attack men or plow through native villages without provocation.

Except in cool, cloudy weather or when disturbed by hunters, elephants do not travel by daylight. During the hottest hours the members of a family herd huddle together in any shade they can find and sleep standing up. No one has ever reported seeing an African elephant lying down to rest in the jungle, though tame Asiatic elephants frequently rest in this way. Toward sundown the herd saunters to the nearest river or lake or waterhole to drink and bathe. At dark they all start out to feed.

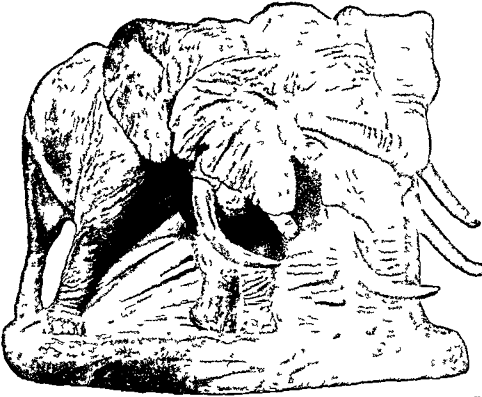
The pace is set so that even the very young and the very old can keep up. If a mother with a baby falls behind, her mate and several other members of the herd will remain to pro-

HOW THE ELEPHANT GOT TUSKS AND TRUNK



The Elephant started several million years ago, with a tapir-shaped head. The drawing (1) is based upon a fossil found in northern Africa. As ages rolled on, the upper lip, still carrying the nostril, grew longer and drooped, while the "eye teeth" commenced to sprout out into tusks (2). This development reached its height in the mammoth of Glacial times (3). The modern elephant is a smaller variety of the mammoth type. The letters "N," "L," and "T" indicate the position of "nostrils," "lips," and "tusks" in each case.

HELPING A "WOUNDED COMRADE



This well known statue group of elephants by Carl Akeley stands in the Ame ican Museum of Natu al History in New York C ty It shows two e ephants support ng a wounded comrade between them Elephants are social anima s and t is their hab t to stand by each othe in danger

tect them A male and female once mated will usually continue to travel together Their attachment naturalists believe endures as long as they both live

As the herd straggles along the elephants push down young trees with their shoulders and chests or uproot them with their tusks to feed on the tender roots twigs and leaves In the open meadows they gather up tufts of grass with their trunks and stuff them into their mouths At times a herd will invade the fields of natives to feed on bean plants millet banana trees and other crops but it will never enter villages or destroy huts Only the solitary rogue elephants do this

A herd may range over a fifty mile radius in the course of a single season Seldom does it sleep in the same place for two days in succession Bulls of different herds occasionally fight when they meet but usually herds mingle on friendly terms Many pictures have been taken from airplanes showing vast elephant armies made up of many family herds travel ing over the same route toward new feeding grounds

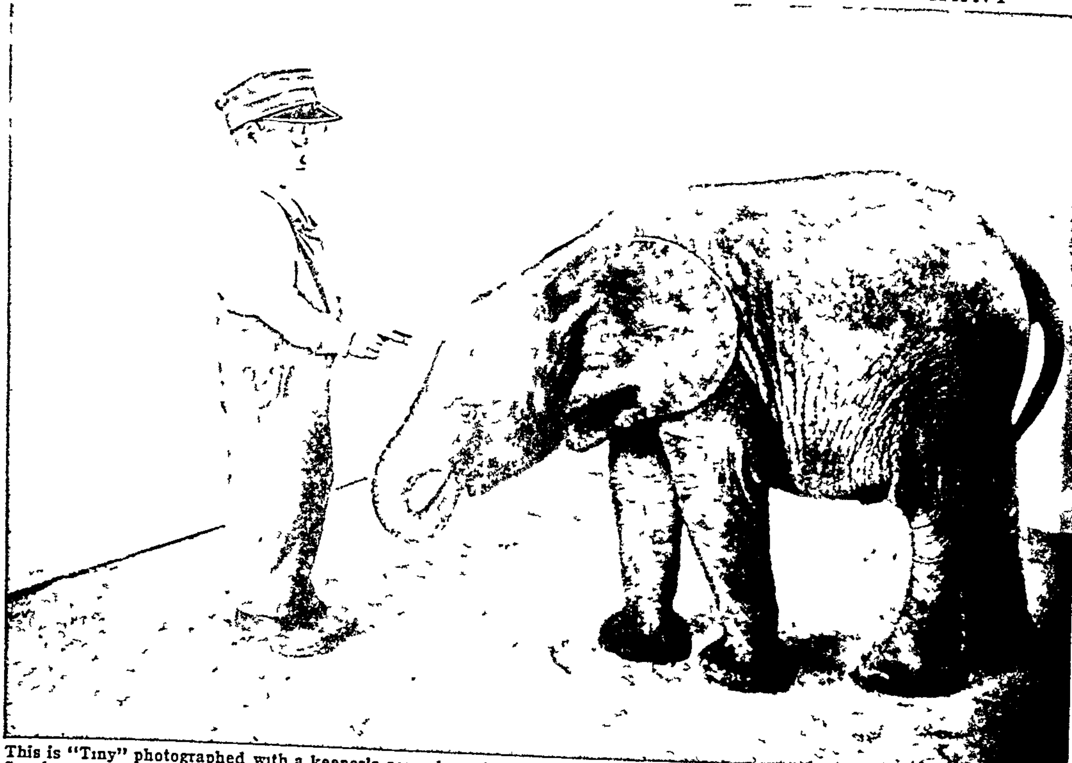
At birth the baby elephant is about 3 feet tall and weighs about 200 pounds It has a sparse coat of woolly hair which gradually disappears It takes its mother s milk with its mouth and not as some people imagine with its trunk The young elephant is nursed by its mother for about two years and remains under her protection for two years more The period between mating and the birth of a young elephant is about 22 months. Thus female elephants as a rule bear young not oftener than once every four or five years

Structure of Elephants—The Trunk

Trunk tusks and feet are the elephant s most con spicuous features The trunk is a prolongation of nose and upper l p combined The two t bes of the nostrils surrounded by muscle run the whole length The trunk is an extraordinarily powerful and yet deli cate instrument With it the elephant can break a large branch from a tree or p ck up a peanut The upper side is tough and is often used for pushing but the under s de is very sens tive

The elephant guards his trunk carefully and never strikes down with it in fighting The common idea that he uses his trunk in this way arose from the at t tude he takes when he suspects danger Because his eyesight is poor he relies for warning on his keen senses of smell and hearing Hence when he is suspi-

A YOUNG "ROUND-EARED" OR "PIGMY" ELEPHANT



This is "Tiny" photographed with a keeper's son when she first reached the New York Zoölogical Park. Her height was 3 feet, 7 inches, and she weighed 425 pounds. Her age was estimated at three years. She lived at the zoo for eleven years and accumulated a weight of 2,500 pounds before she died. Notice the round ears that are characteristic of the pigmy species. The photograph also shows clearly the spreading, pad-like front feet that all elephants possess.

cious, he raises his ears to catch the slightest sound and thrusts his trunk outward to probe the air with noisy sniffs. But when charging or defending himself, he curls up his trunk out of harm's way.

The elephant drinks by drawing water half-way up his trunk and then squirting it down his throat. He can draw in corn and other grain and blow it into his mouth in the same way.

The Useful Tusks

The lower jaw has no front teeth, and the upper jaw has only one pair. It is these two teeth, corresponding to incisors, that grow so long and form the tusks. They are "second teeth" which grow out after the baby elephant's tiny milk tusks are shed. The ivory of which they are composed is pure dentine, with a short cap of enamel at the tip which is soon scraped off (*see* Ivory; Teeth, picture).

The tusks keep on growing as long as an elephant lives. If he uses them a great deal, they wear away at the points as they grow at the roots. Because one tusk is likely to be used more than the other in digging up roots, the two are seldom of equal length. The heaviest known single tusk weighs 235 pounds; the longest measures 11 feet, 5 inches. These are freaks. A tusk weighing 100 pounds is well above the average for African elephants; the average for Asiatic elephants is much less. An elephant burdened with very heavy tusks may have to abandon the family herd because their weight prevents him from keeping up.

There are six molar teeth on each side of the upper jaw and six on the lower jaw; but never more than one or two of the six are in use at the same time. As those in front are worn away, the successively larger molars behind come into place. Thus an old elephant may be left with only a single huge molar above and one below on each side.

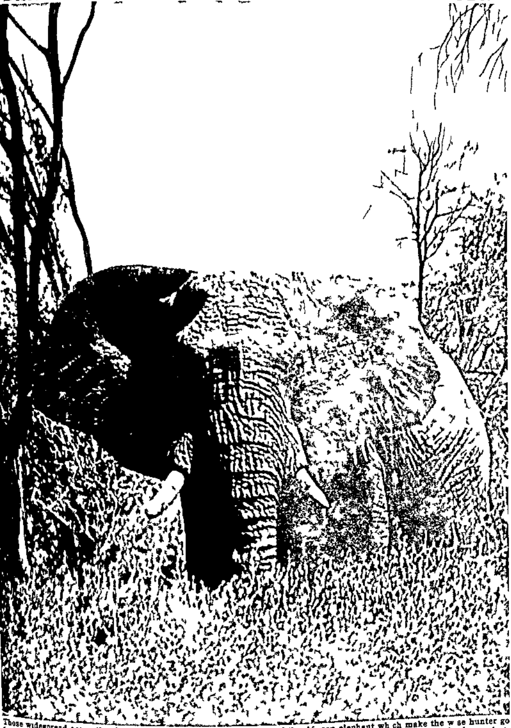
The Elephant's Padded Feet

An elephant's foot closely resembles the *plantigrade* foot of man (*see* Foot), except that the heelbone rests on a thick pad of flesh. Thus the elephant's hind leg has no conspicuous heel or hock joint as does the hind leg of a horse or dog. The free joint is the knee, and the elephant is one of the few animals that can kneel on its hind legs.

When the elephant walks he sets his hind feet down in the track left by his front feet. Picking his way with amazing silence through a forest, he needs to watch only where he puts his front feet. In deep mud or bog his flanged feet spread out as they go in and contract as they come out, so they do not stick.

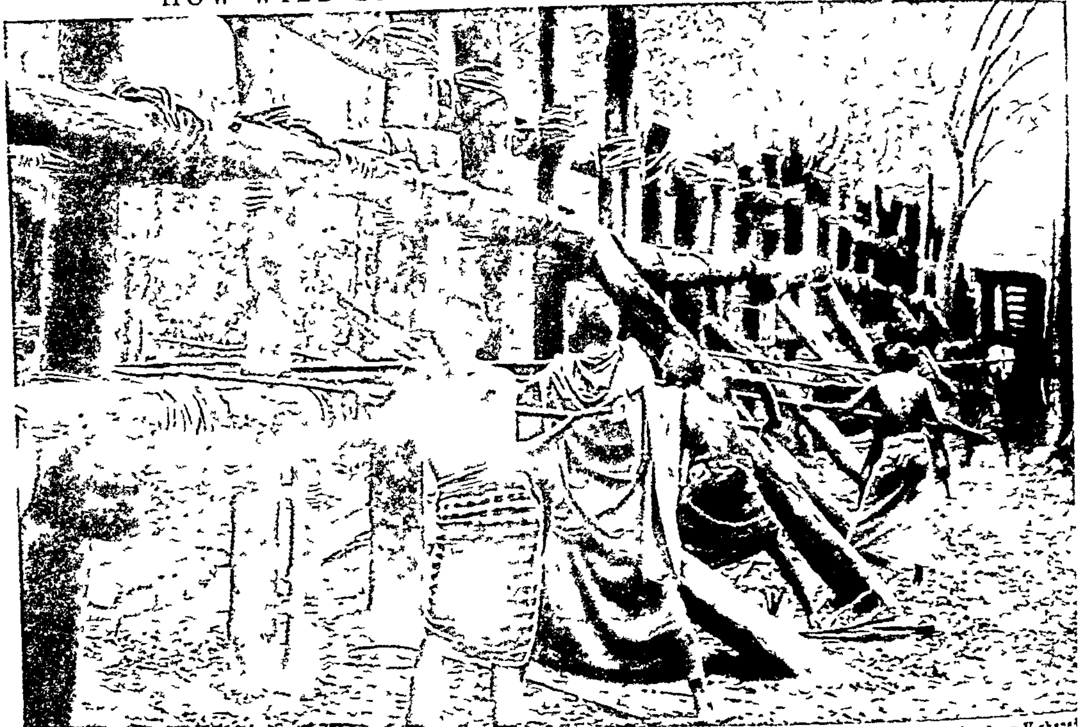
Elephants are not fast runners. Fifteen miles an hour is near their limit, about half the speed of a

DANGER SIGNALS FOR THE ELEPHANT HUNTER



Those widespread ears—that intent look—are the danger signals of the African elephant which make the wise hunter go for cover. Although usually peaceful, an elephant when alarmed may charge the intruder with the force of a locomotive accompanied by the terrifying sound of its angry trumpeting. If a man can climb a tree or other elevation above the elephant's low line of vision he may escape death beneath the animal's great trampling feet.

HOW WILD ELEPHANTS ARE CAUGHT IN ASIA



To make ready for an elephant round-up in the jungles of Southeastern Asia, natives build a corral or "keddah" with a long V-shaped approach Heavy posts, braced with beams, and bound with rattan, form the stockade. Then beaters surround a wild herd, and with a frightful hubbub of shouting drive it towards the pen Bellowing furiously, the animals charge blindly down the runway into the trap, while outside, natives with long poles prod the captives back from the walls to keep them from plunging through.

good running horse. They are, however, singularly agile, despite their bulk, in climbing up and down hills. Their running gait is the same as their walk —a shuffling stride. They can neither trot, gallop, nor jump. A deep ditch only seven feet wide stops them, for this is wider than the longest stride they are able to take. They are, however, at home in deep water, and can swim for six hours at a time. They sink almost out of sight, with the trunk held up high for air.

Only the rhinoceros, the hippopotamus, and the tapir have hides as thick as the elephant's That is why these animals are called *pachyderms*, which means "thick-skinned" The hide on an elephant's shoulder may be an inch and a half thick. All over his body it is loose and wrinkled On the tail grow long coarse hairs larger than the lead in a pencil These hairs are made by natives into rings and ornaments.

Contrasts in African and Asiatic Species

On the forefoot the African elephant has four nails; the Asiatic elephant, five. On the hind foot, the African has three nails; the Asiatic, four. The African elephant has two nipple-like "fingers" on the tip of its trunk; the Asiatic elephant has only one. The surface of the African elephant's trunk is divided crosswise into pronounced ridges and grooves; the trunk of the Asiatic elephant is smoother. The African elephant has much larger ears and holds its head higher than the Asiatic elephant. Virtually all African males and most females have tusks, many Asiatic males and nearly all females are tuskless

Before the white man began to settle in Africa, the African species ranged over the whole tropical region from sea level to the timber line of such snow-capped peaks as Kilimanjaro and Ruwenzori. Today elephants are plentiful only in the less settled central and eastern sections. The range of the Asiatic elephant extends through the forested parts of Ceylon, India, Burma, Thailand (Siam), Cochin-China, and down the Malay Peninsula to the island of Sumatra

The Pigmy Elephants and the Albinos

A third species of elephant is the "round-eared" or "pigmy," elephant, found in Liberia and the Cameroon Mountains. These differ from the African species chiefly in size and the shape of the ears, but they are not so small as the name "pigmy" implies, for they reach a height of six or seven feet and a weight of more than a ton.

The "white elephants," occasionally found in Asia are not a separate species but merely albino varieties of the common species. Elephant worship plays a part in several oriental religions The white elephant however, is particularly venerated in Thailand Until recent years it was pictured on Thailand's flag.

A "SELF-STARTING" SHOWER BATH FOR A HOT DAY IN INDIA

In the wilderness or in captivity elephants like their daily bath Notice how the one standing up here is throwing water over himself with his trunk Kipling has told a "Just So" story about how the elephant got his trunk "A hungry crocodile grabbed the nose of a too-curious little elephant and in the struggle that followed pulled it out long The other elephants laughed at the funny new nose of the little elephant until they saw how useful it was and what fun he had squirting water with it Then they all went to the crocodile and had their noses stretched, too"

Though it has been said that elephants live as long as 150 years, there is no actual record of any such age Sixty years is believed to be the maximum length of life in captivity Stories have been told of "elephant graveyards" to which all the elephants from the surrounding country go when they feel death approaching Ivory hunters have searched in vain for these "graveyards" Perhaps the legend arose from the fact that African natives set fire to the grasslands to clear the ground for cultivation, and thus may occasionally cause the death of a whole herd

The use of elephants as beasts of burden in peace and war can be traced far back in history The elephant corps attached to Hannibal's army is famous (see Hannibal) We do not know how the ancients obtained their elephants Today the "keddah" system of capture, shown in a picture with this article, is the chief method employed in India and neighboring countries where "work elephants" are most in demand

After capture, two tame elephants close in on the wild one and hold him until men can hobble his feet with ropes The next step is to get him used to the presence of a "mahout" or driver Feeding friendliness, and firm discipline, plus the example of the tame elephants, soon complete the taming

Elephants in Captivity

The elephant is a striking exception to the rule that wild animals captured when full grown can rarely be domesticated Most elephants that are used as beasts of burden, as well as those in zoos and circuses were born in the wilderness and remained there until they were ten or twelve years old There are several reasons for this Elephants do not breed readily in captivity, and the young are delicate and hard to raise Furthermore, a baby elephant matures very slowly and meanwhile eats enormous quantities of food Thus it is cheaper to let him grow to useful size in his native haunts and then to catch him and tame him The elephant's extraordinary docility makes this possible

The record made by Carl Hagenbeck, the famous German animal dealer, is an extreme example of this docility Within two days he trained six African elephants which had never been worked before to carry loads and their drivers Hagenbeck and many other experienced men say that there is no foundation for the belief that the African elephant is more savage and dangerous, or less easily trained, than the Asiatic elephant In recent years many elephants have been trained to work in the Belgian Congo

In his work an elephant may be called upon to push heavy burdens with his head, to pull with a harness, or to drag logs with a cable which he holds in his teeth If he has tusks, he may use them in various ways, but he never pulls loads with his trunk

In India, elephants are sometimes used in tiger hunts The hunter takes his place on a platform saddle or "howdah," strapped to the elephant's back and beaters range through the jungle to drive out the tigers When the great cats draw near, the elephant

gives warning, and so prepares the hunter for his shot. The chief danger to the hunter, it is said, is on the rare occasions when a wounded tiger leaps on an elephant's back and the elephant madly runs under overhanging tree branches to get rid of his attacker.

In captivity as in the wilds, female elephants are the more steady and trustworthy. Males are seldom found in circus herds. An exception to this was Jumbo, the huge African male made famous by P. T. Barnum, the showman. When Jumbo was killed in a railway accident in Canada in 1885, he was about 25 years old and measured 11 feet, 2 inches high at the shoulder. His skeleton is mounted in the National Museum at Washington, D.C., and his stuffed skin is preserved at Tufts College near Boston.

The elephant's usual willingness to obey commands has given it a reputation for great intelligence. Animal trainers and keepers of zoos, however, question this reputation. They point out that the elephant's brain is relatively small. Whereas it is credited with a good memory for people and places, it is subject to blind panics in emergencies. Its vengefulness has also been exaggerated. A mad elephant is said to be as dangerous to a friendly keeper as to a cruel one.

Elephant Hunting

Elephants are protected by law in most regions where they are found today. Special licenses to hunt them are required. Opinions differ about the danger involved in elephant hunting. Usually a herd flees from the hunter. If surprised at close range, however, both males and females are likely to charge. They try to trample the hunter and pin him to the ground with their tusks. A hunter is usually safe if he can get higher than the elephant's line of vision by climbing a tree or scaling one of the great termite mounds that are common in elephant country.

Elephants stem from a line of animals that developed in Eocene or Oligocene times (*see* Geology). The mammoths were close relatives of elephants and the mastodons were more distant ones (*see* Mammoth). The elephants' closest living relatives are the water-dwelling sea cows (*see* Manatee).

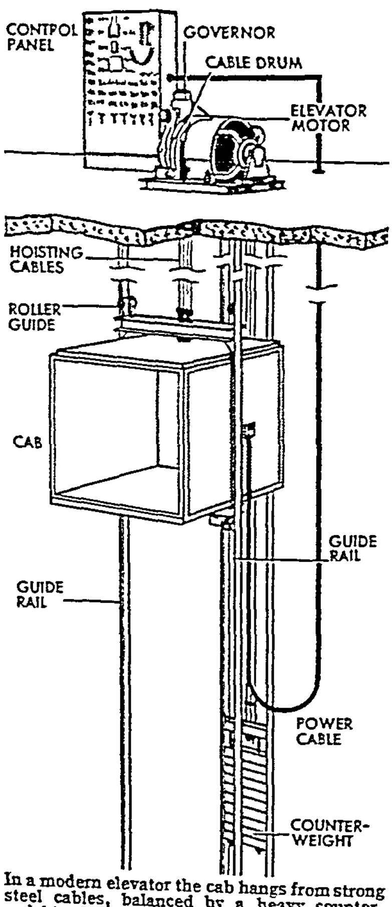
Elephants belong to the order *Proboscidea* and to the family *Elephantidae*. The scientific name of the Asiatic elephant is *Elephas maximus;* of the African elephant, *Loxodonta africanus;* of the pigmy elephant, *Loxodonta cyclotis.*

ELEVATOR AND MOVING STAIRWAY

ELEVATOR AND MOVING STAIRWAY. The tall buildings of today would not exist except for elevators. Suppose a person had to climb stairs to the top of a 40- or 50-story building. If he mounted steadily, it would take him nearly half an hour and he would arrive at the top exhausted. A high-speed elevator, however, can whisk him up in as little as half a minute.

A modern elevator is a complex machine but its working principles are simple. Tie a bucket to one end of a rope; pass the other end up over a pulley and tie it to a stone weighing about as much as the bucket. With the addition of a motor for hoisting these are the basic elements of an elevator. In most modern elevators the passengers ride in a closed metal cab. This travels up and down in the elevator shaft, which has doors opening from within at each floor. Above the shaft, in a room of its own, is the driving motor with a governor to control its speed and a panel of switches and relays to control stopping, starting, and reversing. The steel cables that support the cab are looped around a drum attached to the driving motor. The greater the weight in the cab the tighter the cables grip the drum. From the drive mechanism the cables drop down the back of the shaft and support a heavy counterweight. This weighs about as much as the cab with an average load, and so the motor has only the excess load to lift.

IT MAKES SKYSCRAPERS POSSIBLE



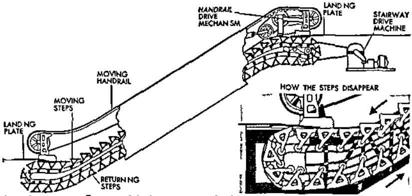
In a modern elevator the cab hangs from strong steel cables, balanced by a heavy counterweight. Safety devices are not shown in this simplified diagram.

Starting and stopping the elevator are accomplished in various ways. The operator may simply use a controller lever in the cab to do this. If the elevator is equipped with a *self-leveling* device, the controller brings the cab level with the floor landing as the operator stops. A development of this is *signal* control, in which the operator presses buttons for the various stops instead of working a hand lever. Such an elevator also stops automatically when someone waiting at a landing presses a button to go up or down. For small buildings there are elevators which the passengers operate themselves. In these the doors often open and close automatically. Signal control usually works by means of a complex system of switches, relays, and electric circuits. In certain modern control systems electronic tubes and circuits take the place of these.

Modern elevators are extremely safe. Several hoisting cables are used and any one of these can support the whole weight. Even if

all were to break safety devices would stop the car The cab is guided in the shaft by vertical rails powerful steel jaws on the cab would grip these rails and halt the cab if it should fall In addition oil buffers (which work on the principle of automobile shock absorbers) are placed at the bottom of the shaft in case other safety devices fail

WHAT HAPPENS INSIDE A MOVING STAIRWAY



A moving stairway offers one of the best ways ever developed to move large numbers of people from one floor of a building to another Such a stairway is an endless chain of steps driven at constant speed by an electric motor Little wheels on each step guide it as it travels up or down The inset diagram at the right shows how the steps fold up as they reach the bottom landing

More useful than elevators for some purposes are moving stairways (The word Escalator is a trade name) A moving stairway is essentially an endless conveyer belt running slantwise between two floors of a building The belt however is a chain of steps arranged to fold and unfold at the top and bottom A flexible handrail moves along at the same speed Two moving stairways are necessary between floors of a building one to handle up traffic and the other to handle down traffic

Moving stairways can carry great numbers of people at a steady speed They are useful in department stores and *in railroad and* subway stations For handling rush hour crowds in stations they are usually made so their direction of travel can be reversed Thus when most of the passengers are going into a station and few coming out two or more of the moving stairways can be set to carry them in

The history of the modern elevator began in the 1850s At that time Elisha Graves Otis invented the safety brake which made passenger elevators practical He also introduced a reversible steam engine for running the hoist drum In 1878 a hydraulic elevator was installed in the Boreel Building in New York City This type of elevator worked on the principle of the hydraulic jack or press (*see* Hydraulic Machinery) Hydraulic elevators led the field for many years and are still used for special purposes

The first electric elevator was designed and built in 1884 The earliest important installation was made in 1889 Until about 1904 the hoisting cable was simply wound on the drum as the cab rose the modern *direct-traction* drive described earlier was developed at that time Various automatic devices followed The speed of elevators steadily increased until today express elevators in tall buildings may travel as fast as 1 400 feet a minute

The first moving stairway was built in 1898 The basic principle has changed very little but the design has been constantly improved One modern type of moving stairway travels at a rate of 45 feet of vertical rise a minute

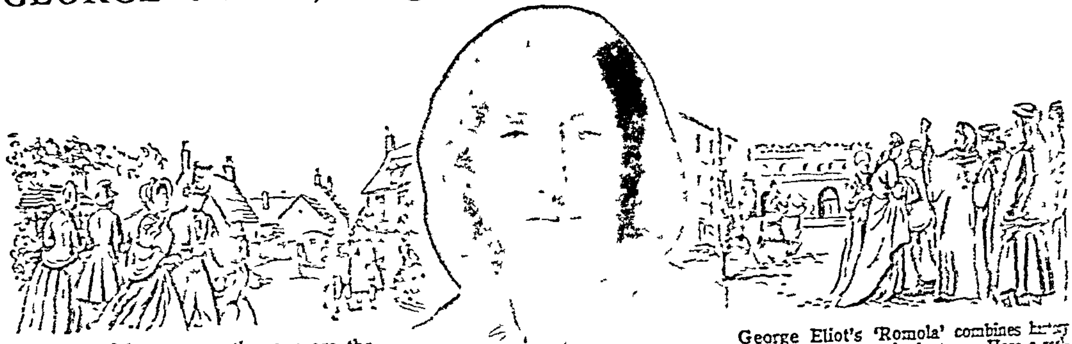
ELIOT, CHARLES WILLIAM (1834 1926) When Charles William Eliot was made president of Harvard University in 1869 higher education emphasized principally mathematics and the classics Eliot eager to give every student an opportunity to discover his individual abilities broke down this traditional system He brought new subjects into the curriculum introduced the elective system abolished compulsory religious worship made it possible to complete the work for a bachelor s degree in three years and built up a first-rate graduate school His writings speeches and correspondence were influential in bringing about reforms in the elementary and secondary schools

Charles Eliot born in Boston was a member of an old New England family His father was a well known Bostonian Young Charles went to the Boston Latin School and entered Harvard when he was 15 After his graduation in 1853 he taught for several years at Harvard and the Massachusetts Institute of Technology He also spent several years abroad studying European educational methods before he became president of Harvard an office which he held from 1869 until 1909 Eliot wrote and spoke extensively on educational political economic and religious questions He gained wide fame for his five-foot shelf ' of books better known as the Harvard Classics' This grew out of a remark of his that ' all the books needed for a real education could be set on a shelf five feet long A publisher asked him to select such a list He did so and the collection had a tremendous sale

Eliot was married twice His first wife Ellen Peabody Eliot died in 1869 in the eleventh year of their marriage leaving him with two young sons His second wife was Grace Hopkinson Eliot

Eliot s principal books are Five American Contributions to Civilization and Other Essays (1898), 'More Money for the Public Schools' (1903) 'John Gilley (1904), Four American Leaders (1906), The Durable Satisfactions of Life (1910)

GEORGE ELIOT, *England's Great* WOMAN NOVELIST



Such peaceful scenes as this one are the settings for many of George Eliot's novels. She tells of the drama and conflict that existed even in the quiet English villages.

George Eliot's 'Romola' combines history and fiction in a vivid story. Here a real-life person, the friar Savonarola, preaches to the crowds in 15th-century Florence

ELIOT, GEORGE (1819–1880). One of England's foremost novelists of the 19th century was Mary Ann (or Marian) Evans, who wrote under the masculine pen name of George Eliot In such novels as 'Silas Marner' and 'The Mill on the Floss' George Eliot created realistic pictures of English country and village life. In 'Felix Holt', 'Middlemarch', and 'Daniel Deronda' she worked on a broader theme. In these novels she depicted the effects of the powerful new forces that were reshaping English ideas (*see* English Literature). In 'Romola' George Eliot used her vast knowledge of history as well as her artistic imagination to portray the life of a young woman living in the world of the Italian Renaissance.

George Eliot well knew the country life from her girlhood days. Later her work as an editor and contributor to several leading journals of opinion kept her completely informed of new ideas in science and social thought. Although she left school when she was 16, George Eliot was one of the most learned women of her day. She read widely in Latin, Greek, Hebrew, French, Italian, and German; she was a talented musician, and such men as the essayist Ralph Waldo Emerson and the philosopher Herbert Spencer treated her as their intellectual equal.

With all these accomplishments George Eliot remained a shy, demure, and completely feminine person. Not beautiful in the ordinary sense, she had much sweetness and charm. Throughout her life she gave great love to those near her, and she depended on their love in return for her own happiness.

A Country Girlhood

George Eliot was born in Warwickshire County, England, on Nov. 22, 1819. Her father, Robert Evans, was manager, or agent, of the Newdigate estate. The family, including Mary Ann's sister, Chrissie, and her brother, Isaac, lived at Griff House on the estate. When she was seven, Mary Ann was sent to boarding school. She spent week ends and long vacations at home, most of the time in the company of Isaac, whom she adored. The scenes between Maggie Tulliver and her brother Tom in 'The Mill on the Floss' come directly from these childhood days with Isaac.

Mrs. Evans died when Mary Ann was 16 Soon after, Chrissie married, and Mary Ann assumed charge of Griff House. She rode with her father as he supervised work on the estate, and during the evenings she read aloud or played the piano for him. He told her stories of his boyhood, many of which Mary Ann later used in her books.

When Isaac married, Robert Evans retired, and father and daughter went to live in nearby Coventry Here Marian (as she now wrote her name) became a close friend of Charles Bray and his family. Bray, a prosperous manufacturer, had forsaken conventional Christianity for his own system of ethics Marian until then a devout Calvinist, attempted to restore his faith. Instead, Bray converted her to his own philosophy. One of Bray's principles was the "doctrine of consequences": if you sow good, you will reap good; sow evil and you will reap evil.

Bray's ideas greatly influenced the girl. She gave up attending church, much to her father's anguish. But she remained devoted to the spirit of Christ's teachings, and during these years at home she translated D. F. Strauss's 'Life of Jesus' from the German. Many of her novels are based upon the consequences of defying moral laws, and her lifelong loving service to others showed her deeply religious nature.

London and a New Life

After her father's death, Marian was faced with the need of finding a new life. She was 30, unmarried, and without a career. Robert Evans had left her with a small annual sum, barely enough to live on. Her translation of the 'Life of Jesus' had been published by John Chapman, and now the London publisher offered her a post as assistant editor of his *Westminster Review*.

The work completely absorbed her. She purchased articles from well-known writers, assembled them into magazine form, read proofs, and wrote book reviews and articles herself. She often worked 18 hours a day, but she still found time for social life with the leading writers and thinkers of the day. Among them was George Henry Lewes, a fairly well-known but not very successful journalist.

Lewes's wife had deserted him, leaving him their three young sons. His plight at first aroused Marian's sympathy and then her deep love. Despite his troubles Lewes had a cheerful disposition that brightened Marian's own somewhat somber nature. In 1854 she became his common-law wife in a union that lasted until his death. Marriage was impossible because under English law at the time Lewes could not get a divorce without insurmountable difficulty.

Their first years together were hard. Lewes still sent his wife money, kept the three boys in boarding school, and supported his old mother. He and Marian worked furiously at their writing and managed to meet their obligations. They even scraped up enough money for a trip to Germany where Lewes gathered material for a biography of Goethe.

Success and Happiness

Lewes soon recognized Marian's growing genius and urged her to try fiction. Her first effort was a short story, 'The Sad Fortunes of the Reverend Amos Barton'. It was accepted by *Blackwood's Magazine* for the January 1857 issue. Marian used her pen name for the first time and for some years no one but Lewes knew who George Eliot really was.

Blackwood's accepted several more stories and reprinted them in a book, 'Scenes of Clerical Life' (1858). The book brought admiring letters from Charles Dickens and others and George Eliot's future as a novelist was assured.

For the next 20 years each new book by George Eliot was acclaimed by the critics and widely read by the public. She published 'Adam Bede' in 1859, 'The Mill on the Floss' in 1860, 'Silas Marner' in 1861, 'Romola' in 1862–63, 'Felix Holt' in 1866, 'The Spanish Gypsy', a dramatic poem in 1868, 'Brother and Sister', a sonnet sequence in 1869, 'Middlemarch' in 1871–72, 'Daniel Deronda' in 1876, and in 1879 'Essays of Theophrastus Such'. The books brought her an income of several thousand pounds a year. George Eliot and Lewes were able to live in a fashionable house, to entertain their friends, and to travel on the continent whenever they wished.

For this success she owed much to Lewes. He relieved her of every possible burden and annoyance, he managed her funds and dealt with the publishers. His constructive criticism and encouragement of her work were invaluable. He achieved some success on his own account with a series of books on nature study and biology. They spent many holidays gathering marine life specimens on the seashore and while George Eliot wrote, Lewes worked with his microscope and dissecting tools. Lewes's sons were devoted to George Eliot and considered her their real mother.

Their happy life together ended with Lewes's death in 1878. George Eliot wrote no more and for a long time she mourned him deeply. In 1880 she became the wife of John W. Cross, a friend of many years. Only a few months later, on Dec. 22, 1880 she died. Cross arranged her letters and journals into a 'Life' published in 1885. This has been the main source for succeeding biographies.

ELIOT, THOMAS STEARNS (born 1888). "I am an Anglo-Catholic in religion, a classicist in literature, and a royalist in politics." T. S. Eliot so defined, and even exaggerated, his own conservatism. The ideas of this important modern poet are perhaps traditional, but the way in which he expresses them is extremely modern. Eliot was one of the first to break away from conventional verse forms and poetic language into a free expression of ideas. For this leadership he is recognized as one of the most influential writers of modern times.

Eliot was born in St. Louis, Mo., on Sept. 26, 1888. His family had produced distinguished Americans since colonial days. Tom Eliot was a frail, bookish boy, more inclined to walk alone along the river than to play with other children. He entered Harvard in 1906, completed his course in three years, and earned an M.A. degree in the fourth. After a year at the Sorbonne in Paris he returned to Harvard.

Further study led him to Merton College, Oxford, in England, and he decided to stay. He married Vivienne Haigh Wood and worked first as a teacher and then in a bank. Precise and moderate in his habits, he devoted his days to earning his living and his evenings to study and writing. He liked cats and even wrote a book about them, 'Old Possum's Book of Practical Cats' (1939).

In 1915 the verse magazine *Poetry* published Eliot's first notable piece, 'The Love Song of J. Alfred Prufrock'. This was followed by other short poems such as 'Portrait of a Lady'. In 1922 appeared 'The Wasteland', considered by many to be his most important work. (The meaning and influence of this poem is discussed in the article on American Literature.) He established his own magazine *The Criterion* and became an executive in an English publishing house.

T. S. ELIOT

Eliot is one of the most important poets of modern times

Eliot became a British citizen in 1928. The same year he was confirmed in the Anglican church. His essays ('For Lancelot Andrewes', 1928) and his poetry ('Ash-Wednesday', 1930) increasingly reflected this association with a traditional culture.

His first drama was 'The Rock' (1934), a pageant play. This was followed by 'Murder in the Cathedral' (1935), a play dealing with the assassination of Saint Thomas Becket (see Becket). 'The Family Reunion' appeared in 1939 and 'The Cocktail Party' in 1949. This last play was especially popular in the United States. The dialogue in all these plays is written in a free but rhythmical verse pattern. Eliot won the Nobel prize for literature in 1948. He returned to the United States for visits and lecture tours but continued to make his home in London.

The GLORIOUS REIGN *of* ENGLAND'S QUEEN BESS

Elizabeth I had a tall graceful figure and loved elaborate dress. In this "rainbow portrait" by the Italian painter Zuccaro, she is wearing a cloak embroidered with eyes and ears, symbols of her wisdom. In her right hand, she holds a rainbow below the Latin inscription "Non sine sole iris," which means "No rainbow without a sun."

ELIZABETH I, QUEEN OF ENGLAND (1533–1603). Elizabeth Tudor was 25 years old when she became queen of England. She rode at once to London from her country home, traveling in a slow procession to give the people a chance to see her. Guns boomed, bells rang, and the people cheered her and scattered flowers in her path. Yet at the beginning of her reign (1558) England was in despair. The country had been weakened by war and religious strife, foreign trade had fallen off, and the treasury was empty. Spain and France were both powerful and both wanted to rule England. The people of England hoped their young queen would soon marry a strong man who would guide her.

But Elizabeth at once took the government into her own hands; and, though she had many suitors, she steadfastly refused to marry. When she died, at the age of 70, she was still the "Virgin Queen." By then rich and secure, England was enjoying its greatest literary period. English ships were sailing into all seas, and the island kingdom was set on a march that was to take it to first place among nations.

Elizabeth's Childhood and Youth

Elizabeth's father was Henry VIII, "bluff King Hal." Her mother was Anne Boleyn, second of Henry's six wives. Henry's first wife, Catherine of Aragon, had given him only one child, the sickly Mary. Henry wanted a male heir, so he asked the pope to annul the marriage. Because the pope refused, Henry broke away from the Roman Catholic church and set himself up as head of the church in England. Then he married Anne. He was disappointed that Anne's child also was a girl. Before Elizabeth was three years old, he had her mother beheaded. Elizabeth remembered him as a thrilling person, but cruel and terrifying (*see* Henry, Kings of England).

Henry gave Elizabeth a house of her own in the country. At times he paid little attention to her, and her governess complained that the princess "hath neither gown, nor kirtle, nor petticoat." Henry did, however, provide excellent tutors, and Elizabeth showed a real love for learning. One of her tutors, Roger Ascham, wrote: "Her perseverance is equal to that of a man, and her memory long keeps what it quickly picks up. She talks French and Italian as well as she does English. When she writes Greek and Latin, nothing is more beautiful than her handwriting. She delights as much in music as she is skilful in it."

Henry's third wife, Jane Seymour, gave him a son, Edward. Henry died when Edward was ten years old, and the boy came to the throne as Edward VI. Elizabeth and Edward were both brought up in Henry's new church. Their half sister Mary was brought up a Roman Catholic. When Edward died (1553) Mary became queen and at once made Catholicism the state religion. Mary suspected Elizabeth of plotting with the Protestants to gain the throne and had her imprisoned for two months in the Tower of London.

When Mary died, there were two claimants to the throne of England. If Elizabeth did not succeed to the throne, the next heir was Mary Stuart of Scotland, a Catholic. Mary Stuart was about to be married to the dauphin Francis of France. If she won the throne of England, both Scotland and England would be joined to France. Philip II of Spain, though a Catholic, threw his influence on the side of Elizabeth because he was jealous of France's power. Later the Spanish ambassador hinted to Elizabeth that she owed her throne to Philip. Elizabeth replied that she owed it to her people. "She is very much wedded to her people," the ambassador wrote, "and thinks as they do."

Queen Elizabeth at Twenty-five

Elizabeth at 25 was tall and slender. Her eyes were bright and her long pale face was crowned with

a mass of curly reddish hair Her health was excellent and she loved riding and shooting She could hunt all day and dance all night But she would turn from these pleasures to spend long hours with her secretaries reading dispatches dictating and carefully examining the accounts She spoke in splendid sentences when she addressed Parliament or the people With her courtiers her speech was elegant and witty—and sometimes coarse because she liked a resounding oath as well as had her father She laughed loudly when amused when angered she showed furious fits of temper She was vain of her good looks especially of her long beautiful hands and she loved extravagant dress and jewels She had a genius for diplomacy being both cautious and wily She understood finance and was extremely frugal in the expenses of government She hated war because it was wasteful of both men and money

The young queen chose as her chief minister Sir William Cecil (Lord Burghley) who was cautious and conservative like herself For 40 years he was her mainstay in both home and foreign affairs Her favorite courtier was the charming and handsome Robert Dudley Earl of Leicester She was perhaps in love with Leicester but she seldom allowed him to influence her judgment

The Problem of Religion

In religious matters Elizabeth steered a middle course between the extreme Protestants and the Catholics She restored the Protestant service but retained many features of the Catholic church including bishops and archbishops She hoped this compromise would produce unity in the state but the Catholics who formed a majority of her subjects were not reconciled From time to time some of them plotted with Spain or France to put Mary Stuart on the throne in place of Elizabeth France and Spain were rivals and Elizabeth was usually able to play one off against the other She even used courtship as part of her diplomatic game She refused to marry Philip II of Spain but held out hopes to more than one of his royal relatives when France seemed to threaten Later when Philip turned against England Elizabeth encouraged French princes To cut Scotland s ties with France she gave secret help to the Scottish Presbyterians She also aided the Protestant Netherlands when they revolted from Spain

Mary Stuart returned to Scotland in 1561 after the death of her husband Francis king of France In 1568 she was compelled to flee across the English border to ask Elizabeth s help Elizabeth kept her a prisoner for 19 years Finally Mary was accused of having a part in the so-called Babington plot to assassinate Elizabeth Parliament demanded her execution Elizabeth signed the warrant and Mary Stuart was beheaded in 1587 (*see* Mary Queen of Scots) In the last years of Elizabeth s reign Catholics were cruelly persecuted and many were put to death

Defeat of the Spanish Armada

During the first 30 years of Elizabeth s reign England was at peace Commerce revived and English ships were boldly venturing across the seas to the West Indies There they came into conflict with Spain and Portugal which owned and ruled the whole New World and claimed a monopoly of trade English smugglers broke through the blockade and made huge profits by selling in the West Indies Negroes they had seized in Africa John Hawkins Sir Francis Drake and other English seamen also waylaid Spanish ships on their way home and seized their gold Elizabeth aided the English privateers with ships and money and shared in their profits and stolen treasure Philip II finally decided to put an end to these attacks by invading and conquering England

After years of preparation Philip assembled a great fleet of his best and largest warships called by the Spanish the Armada (that is fleet) In 1588 the Armada sailed into the English Channel The English were waiting for them and at once put out to sea Their ships were of newer design smaller than the Spanish galleons but faster and more heavily armed In a nine-day battle they inflicted terrible losses on the enemy The ships that escaped ran into bad weather and only a few returned to Spain (*See also* Armada Spanish) English ships then carried the war to Spain When the struggle ended—after the death of both Elizabeth and Philip—no Spanish fleet dared to contest England s command of the seas

England s Golden Age

The most splendid period of English literature called the Elizabethan Age began in the later years of Elizabeth s reign Francis Bacon writer of the Essays was one of the queen s lawyers Edmund Spenser wrote the Faerie Queene in her honor Shakespeare acted before her but at the time of her death he was still a young man and had not yet written his great tragedies Elizabeth enjoyed plays but there is no evidence that she appreciated Shakespeare s genius nor that Shakespeare appreciated her

Elizabeth was 55 years old when the Spanish Armada was defeated Her joy in the victory was soon followed by grief because her great favorite Leicester died a few months later In 1598 her faithful minister Lord Burghley passed away In her court appeared young men—Sir Walter Raleigh brilliant and adventurous and the Earl of Essex a handsome young soldier Essex fell from favor and Elizabeth had him executed for trying to stir up a rebellion against her She died two years later in 1603 at the age of 70 and was buried with great magnificence in Westminster Abbey Mary Stuart s son James VI of Scotland was proclaimed James I of England thus uniting the crowns of the two kingdoms

The things we think of chiefly as marking the reign of Elizabeth are the religious question the defeat of the Spanish Armada and the flourishing of literature Also important however were hundreds of laws on shipping commerce industry currency reform roads poor relief and agriculture These laws shaped the policy of England for more than two centuries after Elizabeth s reign had ended (*See also* English History English Literature)

ELIZABETH II—*Queen of* GREAT BRITAIN

ELIZABETH II (born 1926). Like Elizabeth I of England's Golden Age, Elizabeth II came to the throne when she was 25 years old "A fair and youthful figure," said Winston Churchill, "princess, wife, and mother, is heir to all our traditions and glories." The young queen had already won the affection of the British people by her charm and thoughtfulness, her modesty and simple dignity. On her 21st birthday she had broadcast from South Africa: "I declare before you all that my whole life, whether it be long or short, shall be devoted to your service and the service of the great imperial family to which we belong."

QUEEN ELIZABETH II

Elizabeth is 5 feet 4 inches tall. Her eyes are blue and her hair is light brown. This picture was taken in 1951.

Elizabeth's father was Albert, Duke of York, second son of George V. Her mother was Lady Elizabeth Bowes-Lyon, a member of the Scottish aristocracy. Princess Elizabeth was born April 21, 1926, at the London home of her mother's parents, Lord and Lady Strathmore. Five weeks later she was baptized at Buckingham Palace and christened Elizabeth Alexandra Mary, after three queens of her country. She was four years old when her sister, Margaret Rose, was born (Aug. 21, 1930). In spite of the difference in their ages, the two little princesses enjoyed a close companionship. Margaret Rose was lively and mischievous. Elizabeth (called Lilibet in her childhood) was rather serious and thoughtful.

Childhood of the Little Princesses

The family's London home was a large Victorian house at 145 Piccadilly. Summer vacations were usually spent in Scotland and week ends at the Duke's country house, Royal Lodge, in Windsor Great Park, 25 miles west of London. Here the children had a playhouse, a gift of the people of Wales. Its name was "Y Bwthyn Bach," or The Little Thatched House. It was complete with small furniture, linens, electric lights, plumbing, and windows that opened and shut. Since only children could stand up in it, the princesses themselves cleaned it and kept it in order.

The little princesses did not go to school but were taught by a governess, Miss Marion Crawford, a young Scottish woman. Their daily routine varied little from day to day. Elizabeth, at the age of five, rose at six o'clock and went out for a riding lesson with a groom. After breakfast she and her sister went to their parents' room. They spent the rest of the morning with their governess. After lunch they had lessons in French, voice, and piano. In the afternoon they played in the garden, usually with their governess. They would become so absorbed in their games of hide-and-seek or "sardines" that they seldom noticed the people who would gather outside the garden fence to watch them. They rarely had the company of other children, but they had many pets, particularly horses and dogs. Occasionally their governess would give them a special treat by taking them for a ride in the Underground railway or on top of a bus. They dressed simply, in cotton dresses at home and in plain tweed coats, berets, and walking shoes when they went out They were put to bed very early, after an evening visit with their parents

Heiress to the Throne at the Age of Ten

Elizabeth's carefree days ended in 1936. George V, her grandfather, died early in that year, and before the year ended her Uncle David (Edward VIII) abdicated. Elizabeth's father then became king, as George VI. and Elizabeth became heiress presumptive to the throne (*see* Edward VIII; George VI). The family moved into Buckingham Palace, the royal residence, which was more like a museum than a house. From the princesses' rooms in the front, it was a five-minute walk to the garden in the rear.

From this time, Elizabeth began to be trained for her future duties From her parents and her grandmother, Queen Mary, she learned court etiquette and diplomatic practice. She studied the geography and history of the Commonwealth countries and the United States and was driven to Eton College for private lessons in constitutional law. She disliked arithmetic, and Queen Mary decided she would have little use for it.

Elizabeth was 13 when the second World War broke out (1939). The next year bombs began to fall on London and the princesses were sent for safety to the grim fortress of Windsor Castle. On Oct. 13, 1940, Elizabeth returned to London to make her first broadcast, from a room in Buckingham Palace. In a clear confident voice she told children everywhere that the children of Britain were "full of cheerfulness and courage." Before the war ended, she joined the women's branch of the army and took training as an automobile driver and mechanic.

Elizabeth had the privilege, often denied to royalty, of marrying a man she loved. During the war she met Prince Philip, a blond handsome officer in the royal navy. Philip was born June 10, 1921, on the Greek island of Corfu. As a son of Prince Andrew of Greece, he was in line for the Greek throne; but he had no Greek blood. Through his mother, Princess Alice, he was descended, like Elizabeth, from Queen Victoria of England. He had been educated in Scotland under the care of his uncle and guardian, Earl Mountbatten.

As soon as the war ended, Philip became a frequent visitor at the palace, coming in, the governess said,

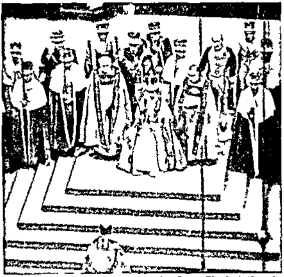
SCENES FROM THE LIFE OF QUEEN ELIZABETH II

On her tenth birthday Princess Elizabeth posed for th s p ctu e w th her s s er Princess Margaret Rose

In 1938 the princesses rode w th their grand mo her Queen Mary in the Troop ng of the Co or ceremony on the King s officia birthday

As pa rol leader in he F rst Buckingham Pa ace Company of G l Gu des Princess E zabeth earned to t e knots for First Aid.

Princess Elizabeth was 21 when she married the Duke of Edinburgh in a sp endid serv ce at Westminster Abbey Th s is the official wedding portrait taken after the marriage



The Archb shop of Canterbury app oaches Queen Elizabe h II as she sits on her throne during the brilliant coronation June 2 1953

After the co onat on ceremony *Elizabeth II* appeared on the balcony of Buckingham Palace with Prince Charles P incess Anne, Queen Mother Elizabeth the Duke of Edinburgh and the royal pages.

"like a refreshing sea breeze." Before the king announced the betrothal of the young couple, Philip dropped his title of prince to become a British citizen and took his mother's family name, Mountbatten. The king then created him Duke of Edinburgh. Gifts for the young couple poured into the palace from all over the world. On Nov. 20, 1947, they were married at Westminster Abbey. A son, Prince Charles Philip Arthur George, Duke of Cornwall, was born Nov. 14, 1948, and a daughter, Princess Anne Elizabeth Alice Louise, on Aug. 15, 1950.

Elizabeth Is Proclaimed Queen

Even before she became queen, Elizabeth served the government as a skilled ambassador. In 1948 she visited Paris and was acclaimed by the French people. In 1951 she and her husband made a six weeks' tour of all the provinces of Canada and then flew to Washington, D. C. (October 31), for a brief visit with President and Mrs. Truman at Blair House.

The royal couple were just beginning a five months' tour of the Commonwealth countries that was to have taken them to Ceylon, Australia, and New Zealand, when George VI died (Feb. 6, 1952) and Elizabeth automatically became queen. She and her husband were in a hunting lodge in Kenya, East Africa, when they received the news. They started at once by plane for London, and on February 8 the new queen took the oath of accession before the Privy Council.

The brilliant pageant of the coronation took place June 2, 1953. More than a million cheering people lined the five-mile route of the royal procession to Westminster Abbey. The queen rode in the gilded state coach. In a long and solemn ceremony, the Archbishop of Canterbury anointed the queen on her hands, breast, and head. Then the regalia of her authority were brought to her; and finally the Archbishop placed on her head King Edward's crown. She was crowned queen not only of Great Britain and Northern Ireland but of the independent states of Canada, Australia, New Zealand, the Union of South Africa, Pakistan, Ceylon, and about 50 other lands of the largest political group in the world. In 1953–54 the Queen, accompanied by the Duke of Edinburgh, made a six-month tour around the world to visit the lands of the Commonwealth and strengthen the ties that bind them to the "Crown." (*See* British Commonwealth and Empire.)

ELIZABETH, N. J. Ever since its settlement in 1665 Elizabeth has grown because of its nearness to New York City and New York Bay. At first it was a farm center and sold its produce to Manhattan. Today it is one of Greater New York's residential and industrial centers. It is the southernmost of the closely built cities on the New Jersey shore of New York Harbor. Newark adjoins it on the northeast. To the east lie the waters of Newark Bay and Staten Island Sound. Staten Island is reached by ferry or over the Goethals Bridge.

The English won the area from the Dutch in 1664, and the next year Philip Carteret came to it as the first English governor of New Jersey. It is said he named the site Elizabethtown, for the wife of his cousin, Sir George Carteret, one of the New Jersey proprietors. Elizabeth was the New Jersey capital until 1686 when the government moved to Perth Amboy. The first industries were gristmills and sawmills. A brewery, shipbuilding yard, and tannery were soon added. Oyster gathering and fishing also provided occupations. During the American Revolution, British soldiers from Staten Island often raided the town.

A highway, and later a rail line, linking New York and Philadelphia, ended at Elizabeth; ferries connected the town with New York. Jersey City eventually became the more important terminal. In 1873 a sewing-machine factory began operation, and sewing machines are still an important product. Other modern manufactures include furniture, printing presses, refined petroleum, chemicals, clothing, and machinery.

The county historical society maintains a museum in the Elizabeth courthouse. Boudinot House, built about 1752, was the home of Elias Boudinot, a president of the Continental Congress. The Belcher Mansion, built about 1742, still stands. Princeton University was established in Elizabeth in 1746 as the College of New Jersey; later it was moved to Newark and then to Princeton.

Elizabeth is the seat of Union County. In 1740 King George II chartered Elizabeth a free borough and town. In 1789 the state incorporated Elizabeth as a town and in 1855 granted it a city charter. Its wharves and docks, in a part of the city called Elizabethport, are under the Port of New York Authority. The city is governed by a mayor and council. (*See also* New Jersey.) Population (1950 census), 112,817.

ELK. When Americans and Canadians use the name "elk" they usually mean the big deer which the Shawnee Indians called *wapiti*. The European elk, on the other hand, is an animal almost identical with the moose. Thus, when the English speak of the American elk, they usually mean the moose. Efforts to put an end to this confusion by bringing the name "wapiti" into popular use in America have so far failed. This article, then, deals with the elk, American style. (For the elk, English style, *see* Moose.)

The elk in question is the second largest member of the deer family, the moose being the largest (*see* Deer). The male elk is about five feet in height at the shoulders and may weigh from 600 to 800 pounds. Head, neck, and chest are dark brown; the rest of the body is pale brown except for a large white patch on the rump. Its backward-sweeping antlers have a spread of three to five feet, with five to seven points on each branch. The cow elk weighs from 500 to 600 pounds and has no horns.

Elk once wandered over most of the United States and southern Canada. After the continent was settled they disappeared in the East, but they are still plentiful in the Rocky Mountains. Because of protection given them by game laws, they have increased too fast for their food supply in some regions. Like the other deer, they feed on plants, chiefly grass and leaves. They compete with domestic livestock for pas-

ture and overgrazing has become a problem Many elk starve in winter Some herds have to be fed hay at government expense Hunting is permitted in season to reduce the numbers of the animals

Elk roam the r range in herds moving from the higher lands to the valleys n winter During the mat ng season in the fall fights between the males are com mon Tl ey challenge one another with a far re ıching bugle call a h gl pitched trumpeting that slides do vn the scale into a deep roar The t vo an mals face each other about 20 feet apart paw tl e ground and then crash together Bellow ng with rage they repeat this again and again until the weaker one goes down Rarely is the loser k lled but occasionally the antlers of the fi_hters lock together and both d e of starvation

In March the bulls lose their antlers but with their sharp front hoofs they can still defend the r band from wolves mountain lions and bears In May or early June each cow will give birth to one two or occas onally three white-spotte l calves The gestation period ranges from 249 days to 26? days By fall the bulls antlers l ave grown in again and fight ng is rer e ved

The scient fic name of the elk or wap ti is *Cervus canadensis* In contrast to the flat-horne l moose its antlers are round in cross section A d varf species (*Cervus nannodes*) is found in Kern County Cal f

ELM The American or white elm is a tree dear to all familiar with New Eng land and is famous in American h story The Wash ngton elm at Cambridge Mass under which Wash ngton stood when he took command of the Amer an army an l the elm under which William Penn made a treaty with tl e In lians are notable examples Tl e American elm s a magn ficent tree sometimes towering to 125 feet Its height and its great arching limbs present a most stately and graceful appearance In many Amer can towns the long arms reach well across the wide roadways Such elms are giants in size Many specimens have trunks exceeding six feet in diameter The range of the spec es is from Newfound land to Florida and westward to the Rocky Moun ta ns In recent years caterpillars of the gipsy and brown ta l moths and Dutch elm blight and other tree d seases have done irreparable damage in spite of mil lions of dollars spent by the state and national govern ments in combating them As a result some of the finest specimens of these once glorious trees have been destroyed

The slippery elm (also called the moose or red elm) is another American species Its inner bark has a pleasant taste and becomes slippery or slimy when chewed It once was supposed to have medicinal qual it es The tree grows to 60 or 70 feet in he ght and has a broad flat cro vn and spreading branches

The rock elm (called in some places the cork or hickory elm) is found from Canada south to Tennessee and west to Nebraska It is d st ngu shed by small corky ridges on its twigs The winged elm or wahoo of the southeastern states is a much smaller species seldom growing h gher than 50 feet Found only from Miss ss ppi and Arkansas west to Texas the cedar elm (sometimes called the basket elm) blossoms in the autumn

The Engl sh elm is nat ve to western and southern Europe It is somewhat taller than the American elm

A BULL ELK BUGLES"

In the Wyoming footh ls autumn is the mat ng season for the e k Th s magn fi cent bull his an le s now full grown fts his head to bugle a challenge to other bu e ks The winner w ll become leader of the he d

but looks stockier because it has a compact oval head. It stays green longer than the American elm.

The wood of the elm is hard to split, bends easily, and holds nails. Hence it is used in the manufacture of boxes, staves, crates, tools, and furniture.

Scientific name of American elm, *Ulmus americana;* slippery elm, *Ulmus fulva;* rock elm, *Ulmus thomasi;* winged elm, *Ulmus alata;* cedar elm, *Ulmus crassifolia;* English elm, *Ulmus procera.* Bark ashy gray, rough. Leaves alternate. Flowers inconspicuous, in drooping clusters. Fruit winged, flat, enclosing nutlike seed.

EL PA'SO, TEX. In the westernmost corner of Texas on the Rio Grande lies El Paso, a main gateway between the United States and Mexico. To the west is one of the two lowest passes through the Rocky Mountains—a natural avenue for railroads. After the first railroad arrived in 1881 the city grew rapidly. It is now served by six railroads, including the National Railways of Mexico, several air lines, and highways. Across the Rio Grande, at Juarez, begins the historic Central Highway of Mexico to Mexico City.

El Paso is the largest city on the Mexican border. It has no rival in size or commercial importance within a radius of 500 miles. From the rich surrounding lands irrigated by Elephant Butte Dam come fruits and vegetables for canning and cotton for manufacture. Copper and lead ores from New Mexico, Arizona, Colorado, and northern Mexico are shipped here for smelting. Other industries are oil refining and meat packing.

Reminders of Old Mexico add charm to this international city, and Spanish is heard as commonly as English. Its altitude of 3,762 feet and its dry, warm climate draw thousands of visitors seeking health and recreation. Texas Western College, a branch of the University of Texas, is here. Near-by military installations are Fort Bliss, Biggs Air Force Base, and William Beaumont Army Hospital.

El Paso, Spanish for "the pass," is named for a break in the mountains. Spanish explorers came here in the early 16th century. In 1659 the mission of Nuestra Señora de Guadalupe was established just south of the Rio Grande. In 1827 settlement was made within the present limits of El Paso. The city was incorporated in 1873. It is governed by a commission. Population (1950 census), 130,485.

EMANCIPATION PROCLAMATION. One of the most memorable proclamations ever issued in this country was given out by President Lincoln on Sept. 22, 1862. It announced to 3,000,000 slaves that, if their masters were still in rebellion on the coming New Year's Day, they should then be free. The abolitionists had long been urging Lincoln to take this step and had severely criticized him for refusing to do so; but Lincoln had replied, "My paramount object is to save the Union, and not either to save or destroy slavery." If he had decreed emancipation at the beginning of the war, Missouri and Kentucky, and probably Maryland, would have joined the South. After the war had been in progress for over a year there was no danger of this. On the other hand, there was need at this time of enlisting the public opinion of the world in behalf of the Union. Freeing the slaves would do this. Lincoln had accordingly drawn up his proclamation in July 1862 and laid it before the Cabinet. All but one of the members agreed with his policy. Seward approved, but urged that the proclamation should not be issued at that time, for the Northern armies were being defeated and it would seem that the North was appealing to the slaves for aid instead of aiding them. Lincoln agreed to the postponement, but vowed that as soon as the Confederate troops were driven out of Maryland he would issue the proclamation. The occasion came with the victory of Antietam, on September 17, and a preliminary proclamation was issued on September 22. The slaveholders paid no attention to its warning, and so on Jan. 1, 1863, Lincoln issued the final proclamation.

> And from that rich and sunny land
> The song of grateful millions rise,
> Like that of Israel's ransomed band
> Beneath Arabia's skies.
>
> —WHITTIER

The final proclamation did not apply to the border states which were not in rebellion, and it could not be enforced in the regions held by the Confederate troops. But as soon as the Northern armies captured a region, the slaves there were given their freedom. The remaining slaves in the United States were freed by the 13th amendment to the Constitution (ratified Dec. 18, 1865), which decreed that "neither slavery nor involuntary servitude, except as a punishment for crime whereof the party shall have been duly convicted, shall exist within the United States, or any place subject to their jurisdiction."

EMBARGO ACTS. The most famous historical case of embargo in the United States occurred in 1807–1808. England and France were engaged in a long and desperate war, growing out of the French Revolution and the ambitions of Napoleon. England interfered with neutral vessels going to ports controlled by the French, and Napoleon ordered that ships which obeyed the English orders should be seized. American commerce suffered severely. Hoping to bring one or both countries to consider the rights of neutrals, Congress passed a Non-Importation Act in 1806, forbidding the entrance of English goods, but it proved ineffective. Then upon the recommendation of President Jefferson an Embargo Act was enacted (Dec 21, 1807) forbidding American vessels from putting to sea, in the hope that lack of American products would bring the other nations to terms.

The embargo made little impression on England and France, but almost ruined American commerce. In port towns, "not a box, not a cask, not a barrel, not a bale was to be seen on the wharves, where grass had begun to grow luxuriantly," and New England talked of seceding from the Union. Although the embargo was repealed, its ill effects were long in disappearing. It did not even save the United States from the necessity of protecting its rights by force of arms in the War of 1812 (*see* War of 1812).

In the American Embargo Act of 1807, the term *embargo* meant a prohibition by law upon the export of

goods In the first World War belligerent nations and many neutrals placed embargoes on war materials The term was also loosely applied to Britain's policy, in the first and second World Wars of attempting to prevent neutral nations from transshipping goods to and from Germany. In 1935 Congress prohibited the export in wartime of "arms munitions, and implements of war" for use by belligerents In November 1939 Congress repealed this "arms embargo" In 1951 the United Nations resolved to ask member nations to cease shipments of strategic materials to Communist China (*See also* Blockade, International Law)

EMBOSSING Figures produced upon metal leather, paper, textiles, cardboard, wood, and similar materials, when raised above the surrounding surface are the products of embossing It is one of the oldest of the arts, and beautiful examples have come down from very early times It is widely used on leather and cloth in the making of fine bookbindings

Figures that are raised on suitable materials principally sheet metals, brass silver, and gold, may be hammered from the reverse side This process, called *repoussé*, a French word meaning "beaten back," was known to craftsmen of the ancient world Repoussé is chiefly a hand process, but it is now often done by machines Two dies are used one has the figure inset, and the other, or counter die, with the figure raised, forces the metal into the inset die Coins are made by dies that compress the metal disks and leave a raised design on each side

RICHLY DECORATED BRASS AND LEATHER

The craftsman (top) displays examples of the elaborately embossed brassware for which India has long been famous An embosser (bottom) puts finishing touches on a fine leather binding

Another process in which the design is pressed into the material is called *chasing* This is often done on metal and leather work Pressed metal containers such as tea or coffee pots, or ice pitchers, are embossed by placing them inside metal counter dies that have the figures inset The object to be embossed is filled with water under great pressure, and the water transmits the pressure to the metal forcing it into the design in the counter die

Embossing in needlework is done by making many stitches over a pad of felt, wool or other material cut in the desired shape Sometimes figures are pressed into wood, when the wood is planed and then soaked in water, the depressed parts swell above the surrounding surface Metal cut by dies in the industrial arts is also said to be embossed

EMBROIDERY One of the most common forms of decorative needlework, which is found in almost every home today, is called embroidery Table and display linens as well as women's and children's garments often show examples of this art

EMBRYOLOGY The building of an animal's body is one of the marvels of nature An insect a fish or a bird begins developing as an egg, and, as the body takes shape, each tissue and each organ is formed of the materials contained within the egg

After three weeks' incubation of the hen's egg for example, the young chick steps into the world with heart, brain, eyes and other organs all formed Frogs' eggs, laid in the water, undergo similar changes without any care from the parent, tadpoles hatch from them, and in due course of time these tadpoles grow into frogs, with a different kind of body Even the warm blooded mammals which are born alive, start as an egg within the mother's body. But instead of being laid, to hatch in the outside world, the egg is kept sheltered until the new individual is developed, and it is able to exist as a fully formed creature from the moment it is born

The hen's egg is large, because there is a large quantity of food yolk stored up for the use of the growing chick The frog's egg is smaller, because it contains less yolk Some eggs—for example those of starfishes—are smaller than pinheads Some eggs can only be seen with the microscope.

The true starting point of the chick is a tiny cell within the egg—so small it can be seen only under a microscope; and when we look to other animals we find that all of them, no matter how complex, start from a similar tiny cell. Between that simple state and the fully formed animal there are many steps. Therefore the adult stage of any animal represents the last step in a long series of changes.

If we could only follow these, step by step, we should understand all about the construction of animals and their past history. Tracing the stages by which cells emerge into tissues, tissues into organs, and how the organs by combination build the body is called embryology.

It is an important fact to keep before us that the rudiment of all life is a cell (*see* Cell). If we look upon cells as the bricks of organic architecture, the starting point of a many-celled animal is a single brick; but, inasmuch as each egg needs to be fertilized before developing—just as a plant-ovule must be fertilized by pollen before it becomes a seed—the single brick is a compound one, made of material derived from each parent.

The development of all animals is remarkably alike. From the single cell there come, by division, many cells; these continue to feed on the yolk, to grow and divide; and thereby a large number of cells arises. These cells arrange themselves into definite layers, and it is from these layers that all parts of the body are formed.

It took over a half-century after Harvey and Wolff in the first half of the 18th century for this view of cell development to replace the earlier view that the animal existed already formed within the egg, but was exceedingly minute, and that development consisted in the expansion or growth of this animal in miniature. Then K. E. von Baer (1792–1876), the father of modern embryology, showed that all the tissues and organs come from cell-layers or germ-layers. One layer gives rise to nerves, another to skin or feathers or fur, and a third splits and from it come the internal organs, bones, etc. This is the germ-layer theory.

Other scientists broke down the rigid line that was supposed to separate vertebrated and invertebrated animals (those with backbones and those without) and indicated how higher types had been developed from simpler ones. The chick, and for that matter man himself, in the embryo has gill clefts like a fish. These disappear but they give clues leading to the time when all were water-breathers and had use for gills. Thus embryology retraces life's history, contributing important evidence in support of the belief that the higher animals have been evolved gradually from the simpler ones. (*See* Evolution.)

The SAGE *of* CONCORD *and His* TEACHING

EMERSON, RALPH WALDO (1803–1882). No American writer had a more powerful influence on his generation than did Emerson, and none has better stood the test of time. His appeal is universal. Young and old, wise and simple, learned and untaught, turn to him again and again for refreshment. Some of the keenest and best minds in both the Old World and the New have accounted his message of resolute self-reliance as one of the cardinal factors that shaped their lives and thinking.

RALPH WALDO EMERSON
The Teacher of "Self-Reliance"

Emerson's ancestors were Puritans who came to New England in 1635. He sprang from eight generations of ministers. Emerson's father died when the boy was eight years of age, leaving the family poor. He went to Harvard in 1817 and, although elected class poet on graduation, he received no honors for scholarship. Even in those early days he preferred to seek his own mental food rather than to follow meekly the paths laid down by his teachers.

On leaving college, Emerson taught in his brother's school for awhile and then studied for the ministry. His preaching, however, was interfered with by poor health and he was forced to go South. On his return he accepted a Unitarian pastorate in Boston and was married to Miss Ellen Louisa Tucker.

Through all his early years Emerson had been a quiet unobtrusive self-contained person. He thought much, wrote a little, and said less. He was genial and kind in his attitude toward people around him, but he was always most difficult to know intimately. His early married life was happy; and for the first 30 years of his life he seemed destined to follow peacefully in the footsteps of his ministerial ancestry. But underneath the quiet exterior was a steadily growing resolve which was to separate him from the church. Emerson found that even in the simple ritual of the Unitarian service there was much to which he could not agree. He resigned his position as minister, greatly to his relief.

For a time he did not find himself. His young wife died in 1831 and Emerson's own health broke down again. He went to Europe, saw the wonders of the Mediterranean countries, and visited England. There he met most of the great men of letters of the day: Landor, Coleridge, John Stuart Mill, and above all, Carlyle, whom he admired more than any. But it is curious to see that travel and great men meant but little to Emerson. He said in his essay on 'Nature', published some years later: "The difference between landscape and landscape is small, but there is a great

difference in the beholder" As for the men, they seemed to him inferior in intellect, except Carlyle, with whom he corresponded for many years

On Sept 14, 1835, he married Miss Lydia Jackson Previously he had purchased in Concord a house with a pretty garden attached, and there surrounded by his family, he passed the remainder of his life, save for the breaks occasioned by lecture engagements and two journeys to Europe When his house was burned, in 1872, a nation-wide popular subscription was taken and the funds used to rebuild it He died after a short illness on April 27, 1882, and was buried in Sleepy Hollow cemetery on the outskirts of Concord

To understand Emerson s aloofness from men and events one must grasp his way of thinking He believed that great truths come to us by intuition—that is that they come to us unbidden Furious striving avails us nothing truth comes gently and unawares Most modern philosophers do not agree with Emerson, they think that truth may be reasoned out Besides, they are interested in the working out of truth in relation to human life, while Emerson was always on the alert for the first dawning He never finishes but is always beginning and his beginnings have been inspirations to the people of two continents

EMERSON S TRIBUTE TO BEAUTY

"Wherever snow falls, or water flows, or birds fly wherever day and night meet in twilight wher ever the blue heaven is hung by clouds, or sown with stars, wherever are forms with transparent boundaries, wherever are outlets into celestial space, wherever is danger, and awe, and love, there is Beauty, plenteous as rain, shed for thee, and though thou shouldst walk the world over, thou shalt not be able to find a condition inopportune or ignoble"

How are men to arrive at truth? Emerson gives his answer in 'Self Reliance' "To believe your own thought to believe that what is true for you in your private heart is true for all men—that is genius Speak your latent conviction and it shall be the universal sense, for always the inmost becomes the outmost—and our first thought is rendered back to us by the trumpets of the last judgment" "God is in every man" The last phrase is the keynote of what is called the "transcendental movement,' or that faith in the "inner light' of which Emerson was the chief exponent

When Emerson returned to America he had begun to lecture and to write freely He edited *The Dial*, a paper which spoke truth fearlessly, for a few years Harvard asked him to give several addresses, one of which 'The American Scholar, was called by Oliver Wendell Holmes "our intellectual Declaration of Independence" His lecture tours carried him all over the country In those days, one must remember, travel was a series of hardships and inconveniences Emerson reached a large number of people, most of whom did not understand him at all

There was something more than truth that drew the crowds It holds us now when we read the essays in a quiet room, it holds all those who turn to Emerson for enlightenment. In the early days people often came to scoff and remained to listen, much impressed Emerson the man held them He was a man of charm and vigor, he had a style which is almost unequaled Oliver Wendell Holmes said "No one who ever heard him speak will forget the play of his features, the lighting up of his eyes with a rapt inner illumination, the emphatic stamp of his foot when some weighty thought required enforcement" In the matter of style he stands supreme for his power of saying much in little, of so phrasing his thoughts that they sparkle and glow Every sentence seems as good as the one it follows This is true of his poetry as well as his prose—that is the power of stating truth in sharp relief His poems are among the greatest ever written in America

Emerson has been criticized for the lack of organization or plan in his essays But we must remember that he never tried to put plan there One might say that he was too honest He said what he had to say, as it came to him, and considered himself as the mouthpiece Emerson is still read—he is read more and more as the years go on, while many of his critics are forgotten

Emerson's principal works are 'Essays First Series' (1841) Essays Second Series (1844), Poems (1847 1865) Representative Men (1850) English Traits' (1856) The Conduct of Life' (1860) Society and Solitude' (1870)

EMERY In outward appearance emery has nothing in common with the sapphire and other precious stones to which it is related It is a dense, opaque, dull substance, like a fine grained iron-ore ranging in color from reddish brown and gray to blue black It is found in large bowlder like masses in Asia Minor and on Naxos and some of the other islands of the Grecian archipelago Small amounts are found in the United States The rock is made ready for use by breaking it into lumps and crushing these to powder in stamping mills It is then sifted to various degrees of fineness As emery powder is one of the hardest natural substances, it is used for cutting and polishing many kinds of stone Glass stoppers are ground into their fittings with it Plate glass is ground flat by its means When used for polishing metals, it is spread on some kind of surface to form emery-paper, emery cloth, or emery sticks Emery wheels, used for grinding, are a mixture of emery powder and some cementing substance

Emery is an impure variety of the mineral *corundum*, which is chemically an oxide of aluminum The beautifully colored crystalline varieties of corundum are known as sapphire, oriental ruby, oriental topaz, etc Corundum in less beautifully colored forms is used like emery for grinding and polishing Ontario is the chief source of supply

The Spectators at a Basketball Game Express Grief, Excitement, Pleasure, and Amusement

EMOTION *and How It* AFFECTS OUR LIVES

EMOTION. The character of every individual's life is determined by his emotions. No matter what he may be doing, there is always an undercurrent of emotion—anxiety or fear, pride in his work, friendliness and sympathetic interest in others, or maybe only bitter discontent. Whether he is a happy, lovable person or one who is hostile, resentful, and discouraged depends on his ability to control his emotions. Plainly it is important to understand them.

The word emotion comes from the Latin verb, *emovere*, which means "to move." Because an emotion *moves* us to do the things we do, some psychologists have compared it to the mainspring of a watch. Just as the watch would be motionless without its mainspring, so we would be listless and accomplish little or nothing if there were no emotions to motivate us.

This does not mean that emotions are our only source of motivation. We are, of course, motivated by hunger, thirst, and other conditions aroused by bodily needs. The man who has gone for a long time without food becomes hungry. He begins to think about food. If he is asleep he may dream about it. If he is in a group, his conversation will turn toward food. He may become aware of odors drifting toward him from cooking food. He will eventually bestir himself to satisfy his need. If he does not have food at hand or the money to buy it, he may do work which is highly unpleasant in order to get a meal.

Similarly a person is motivated by love for his child. He works to provide a good home for the child and to pave the way for the child's future happiness. He may dream, talk, and think about his child and the task before him as much as he may dream, talk, or think about food when he is hungry.

Some Emotions Are Protective

Emotions motivate us to accomplish long-range goals such as providing for our loved ones. They also have a protective or preventive function. Suppose that a creeping baby comes in contact with a hot radiator and burns his hand. The pain motivates him to withdraw his hand and crawl away from the pain-producing object. This avoidance of pain is a physiological motive. If the baby were dependent upon this avoidance-of-pain motive alone, he would continue to get hurt. The painful stimulation, however, arouses an emotion of fear. The baby becomes afraid of the

object which causes pain. Fear causes him to avoid the radiator and he does not get hurt. In a like manner the child learns to avoid many other potentially dangerous and unpleasant situations.

How Fears Develop

Not all fears are instilled by actual contact with painful objects. In one experiment a child was made to fear a rabbit, even though the rabbit was harmless and did nothing to frighten him. The experimenter knew that a loud noise arouses fear in most infants. He struck an iron bar behind the infant and produced an immediate startle response, as well as *evidences of fear*. *The rabbit aroused no such reaction.* The child reached for it, stroked it and tried to get closer to it. Then, while the rabbit was still there, the loud noise was made. Next time the rabbit was presented the child hesitated to get close to it. After a few repetitions of the rabbit-noise combinations the infant was just as much afraid of the rabbit as he was of the loud noise. *A conditioned-fear reaction* to the rabbit had developed.

In a somewhat similar manner the child may learn to fear dogs which bark loudly, jump up upon him or push him over. What is even more interesting and significant, however, is the fact that once a fear has *developed in the way described, it may transfer to* other similar objects and situations. The infant who became afraid of a rabbit was thereafter also afraid of white rats, a fur muff and even a Santa Claus mask. Likewise the child frightened by one dog may fear all dogs.

Fears also develop through observing the behavior of other people. A child who sees that its companion is afraid of dogs also becomes afraid. The things people tell us develop fears and other emotional reactions. Our fear of running across the street does not in most instances come from having been hit by a car. We may not even have seen that others are afraid. It usually comes from being told by our parents and teachers what may happen to us if we run across the street without looking.

Positive and Negative Motivation

In thinking of emotion from the standpoint of protection from injury, we have emphasized its negative function. Fear, since it causes us to withdraw from situations rather than to reach out toward new experiences, is clearly a negative emotion. Other emotions with negative aspects are anger, hate, loneliness, discouragement, shame, guilt, boredom and feelings of inferiority. These are learned in various ways, *but largely through our contacts with other* people and through what we read and hear.

Some people are so negatively motivated that, in a manner suggestive of the snail, they withdraw into their shells. When this sort of withdrawal is extreme we say that the person is *introverted* or an *introvert*. Such people are likely to be lonely, with feelings of inferiority. They contrast markedly with the *extrovert* whose emotional undercurrents lead him to reach out and associate with others. We would say that the latter is positively motivated.

Although negative emotions, and especially those with protective functions, have a place in everyday *life, the positive emotions are much more important*. Among them are enjoyment of activity, friendliness, sympathy, love and affection, courage, self respect and esthetic appreciation. The emotionally mature person likes people and feels that they like him. Often he is more concerned with their happiness than with his own. He is tolerant of others. He is able to laugh at himself. He gets out among people and enjoys life.

Becoming Emotionally Mature

How can we develop our positive emotions in such a way as to improve our own happiness and the happiness of those who must associate with us? Although it is possible to cultivate these desirable emotions and to weaken or eliminate any hold which negative emotions may have upon us, the task is not easy.

One reason for the difficulty is that we are often not aware of our own emotional undercurrents. Sometimes it is very difficult to trace the origin of emotionally colored attitudes. We may be afraid of dogs or perhaps only vaguely uneasy in their presence, yet not remember the dog which frightened us during early childhood, the experience of seeing another child frightened, or being told that dogs may bite. A psychologist found that he disliked a certain man but without knowing why. Later he realized that the man had the same name as a villain in a story that he had read years earlier. Many such instances can be cited to show that emotions may influence us without our knowing why.

AN ENJOYABLE GAME OF CHECKERS

Emotionally healthy young people are friendly. They are at ease with members of the opposite sex and enjoy the companionship of other people. They have many interests.

Quite often our emotions seem very vague indeed. We are worried, anxious, or unhappy without knowing why. That something of which we are unaware can control our thoughts and our actions is difficult to grasp. An example or two may be helpful.

You are, let us say, coming home from school with some friends. Under your arm is a book. In talking with your companions, you have completely forgotten the book. Nevertheless, when you placed your book under your arm with the intention of holding it there, your brain began sending appropriate impulses to your arm muscles. Even though you are not thinking about the book, the brain continues to send impulses to the muscles. Your brain has a "set" which controls your actions.

Suppose that a child was dealt with harshly and unsympathetically by his parents except when he was sick. Out of these experiences the child would learn to fear harshness from others except when he could appeal to them by illness on his part. In later years he might retreat into chronic illness as a means of gaining sympathetic attention.

How to Achieve Emotional Maturity

Thus, in order to improve our emotional life, we must know what our emotions are and how they are controlling us. Sometimes we cannot discover these things for ourselves and must seek counsel from those who are experienced in discovering hidden motivation (*see* Psychoanalysis).

A positive attitude toward those around us is conducive to development of emotional maturity. If we "lose ourselves" in others, in interesting work or hobbies, or in worth-while causes, we develop our positive emotions at the expense of the negative ones.

It is also important to have good health. The person who is always irritable and depressed may not be getting enough food of the right kind, the right amount of exercise to keep his body fit, or the necessary amount of sleep.

One can sometimes improve his emotional life by changing the situations which disturb him. If he is lonely, he should make an effort to get out and mix with people. If he is irritated because the owner of a nearby vacant lot leaves it cluttered with trash, he may put pressure on the owner to clear it up. It is often easier to change situations in these ways than to change our emotional habits.

Why Emotional Maturity Is Important

When we are emotionally aroused we have pleasant, unpleasant, exciting, depressing, or other feelings. There are also effects in our inner organs, such as the heart, stomach, liver, nervous system, and spleen. A machine called a polygraph can register the physical reactions to an emotion such as fright. (For picture, *see* Psychology.)

Everyone is familiar with the physical signs of emotion. The person in a sharp attack of anxiety breaks out into perspiration. The angry person reddens and then turns pale. The frightened child trembles. At the same time the blood pressure increases; the pulse beats faster; breathing is more rapid and disordered;

MORE FRIGHTENED THAN HURT

This small boy has caught his finger in a hole in a rubbish can. He is badly frightened as firemen work to free him and expresses his emotion with tears and loud wails for his mother.

the normal processes of digestion are halted; even the supply of blood has been directed away from the stomach and toward the trunk muscles and into the arms and legs. Thus a man who faces sudden danger can perform feats of speed and strength completely impossible under normal conditions.

An area in the brain called the *hypothalamus* is believed to be responsible for preparing the body for emergency action (*see* Brain). The popular belief that the adrenal glands perform this function by pouring adrenalin into the blood stream has not been proved (*see* Hormones).

Most of the time we are not in emergencies, and such excess energy, having no normal outlet, may make us tense, nervous, irritable, and unhappy. This is true when we are afraid without need of being so, when we are anxious without cause, when we are consumed with hatred or resentment, or when we are continually jealous. Some psychiatrists claim that people in whom emotional reactions are prolonged tend to develop high blood pressure, ulcers, and other physical disorders. *Psychosomatic medicine* is concerned with bodily ills due to chronic emotional disturbances.

The control of our emotional life is worth careful thought. To be mature emotionally, to foster the positive rather than the negative emotions, is not only conducive to good bodily health but also to a happy life. Emotional maturity has been achieved by happy, friendly, and courageous people for whom life is a great privilege. Some principles in training the emotions are considered in the article Mental Hygiene.

EMPLOYERS LIABILITY According to the common law in England and America a workman when taking employment agrees to assume all the ordinary risks of industry including not only those resulting from his own negligence but those due to the carelessness of his fellow workers With the increasing use of machinery and steam power accidents in industry became very common In large establishments vast numbers of men were considered fellow servants in the eyes of the law making the recovery of damages impossible in the great majority of cases An Employers Liability Act was therefore passed by the British Parliament in 1880 which defined and enlarged the employer s liability and gave compensation whether or not the accident was due to the negligence of fellow workers Similar acts were later passed in most of the states of the United States

Under such laws the injured workman either had to bring suit or accept what the employer offered This process was slow expensive and unsatisfactory to both workmen and employers Hence the employers liability system has been almost entirely replaced by workmen s compensation laws Nearly all the states have such laws providing definite rates and terms for compensation Federal laws apply to the District of Columbia and to all United States civil employees

The extension of employers liability has resulted in the growth of employers liability insurance by companies which undertake in return for a premium paid by the employer to pay any damages to workmen for which the employer may become liable Recent laws in some states make such insurance compulsory (*see* Insurance) These laws have tended to promote the use of safer machinery and to better working conditions in general thus removing many employee grievances (*See also* Labor)

EMU (*e mu*) This flightless bird of Australia is the second largest bird in the world Only the ostrich is larger The emu stands from 5 to 6 feet high and weighs about 100 pounds The heavy dull brown plumage has no commercial value Unlike its close relative the cassowary the head and neck are feathered and there is no cap or helmet The wings are undeveloped but the bird can run about 30 miles an hour Emus live on open plains where they feed entirely on vegetable matter They are particularly fond of ripening wheat and have become serious pests in Australia s wheat-ranching sections The female lays 6 to 16 dark green or bluish eggs in a cavity in the earth The male incubates the eggs sitting for 54 to 64 days and he also cares for the chicks Emus are easily tamed but they do not breed successfully in captivity The scientific name is *Dromaeus novaehollandiae*

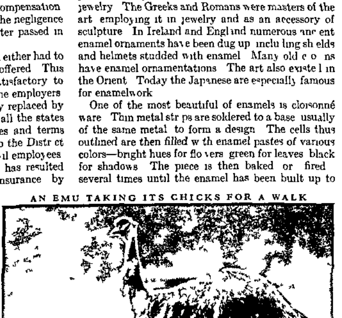
ENAMELING The delicate pieces of cloisonné ware in the jeweler s window the glazed cups plates and vases preserved in museums many of the vanity cases women carry the bright white equipment of bathrooms and the shining kitchen ware that never rusts are all examples of enameling Enameling means coating a base of metal pottery or other mineral substance with finely powdered glass and then heating it until the particles melt together and form a glaze

The ancient Egyptians and Assyrians used enameled bricks of wonderful luster in the walls of their palaces They also used enamel in the decoration of jewelry The Greeks and Romans were masters of the art employing it in jewelry and as an accessory of sculpture In Ireland and England numerous ancient enamel ornaments have been dug up including shields and helmets studded with enamel Many old coins have enamel ornamentations The art also existed in the Orient Today the Japanese are especially famous for enamelwork

One of the most beautiful of enamels is cloisonné ware Thin metal strips are soldered to a base usually of the same metal to form a design The cells thus outlined are then filled with enamel pastes of various colors—bright hues for flowers green for leaves black for shadows The piece is then baked or fired several times until the enamel has been built up to a sufficient height There follow weeks of polishing with pumice stone under running water During this process the rough surfaces become smooth

Another form of inlaid enamel is champlevé This is made by cutting grooves in the metal itself—usually bronze or some other metal less precious than

AN EMU TAKING ITS CHICKS FOR A WALK



When emu chicks go walking one of their parents usually goes along The parent keeps a sharp lookout for danger If dogs or other enemies come too close it may cripple them or even kill them with swift powerful kicks Note the black and white stripes that camouflage the young emus so effectively in the grasslands

gold—to form the design and then filling these grooves with the enamel. A considerable portion of the metal is left as a background for the enamel design. Many valuable old Chinese enamels are champlevé. In

A SPLENDID EXAMPLE OF CHINESE ENAMEL

This figure of Kuan Yin, in the Victoria and Albert Museum in London, shows the mastery possessed by the Chinese artists of enameling over porcelain The perfection of the workmanship and the artistry of the finished product are remarkable.

the later Middle Ages artists began to make painted enamels. A coat of enamel is fused over a metal surface, and a design is painted on this background with colored enamels. Numerous firings are necessary before the work is completed. In the great cathedrals of Europe are some gorgeous translucent enamel windows. Fine painted enamels are produced at Limoges, France.

In recent decades the art of enameling has undergone a marked revival. New processes have been invented which produce enamels of a much greater variety of colors than were formerly known and which are superior in brilliance and durability. The most important industrial use of enamel is giving iron and steel utensils coats of opaque glass.

Into the making of enamels go many substances—feldspar, quartz, fluorspar, borax, boric acid, soda, potash, saltpeter, clays, ammonium carbonate, stannic acid, and water. Many coloring agents are employed. If the enamelware is an intense blue, it is probable that cobalt oxide was used to give it this color. The soft grays, which are so popular, are generally made with nickel oxide.

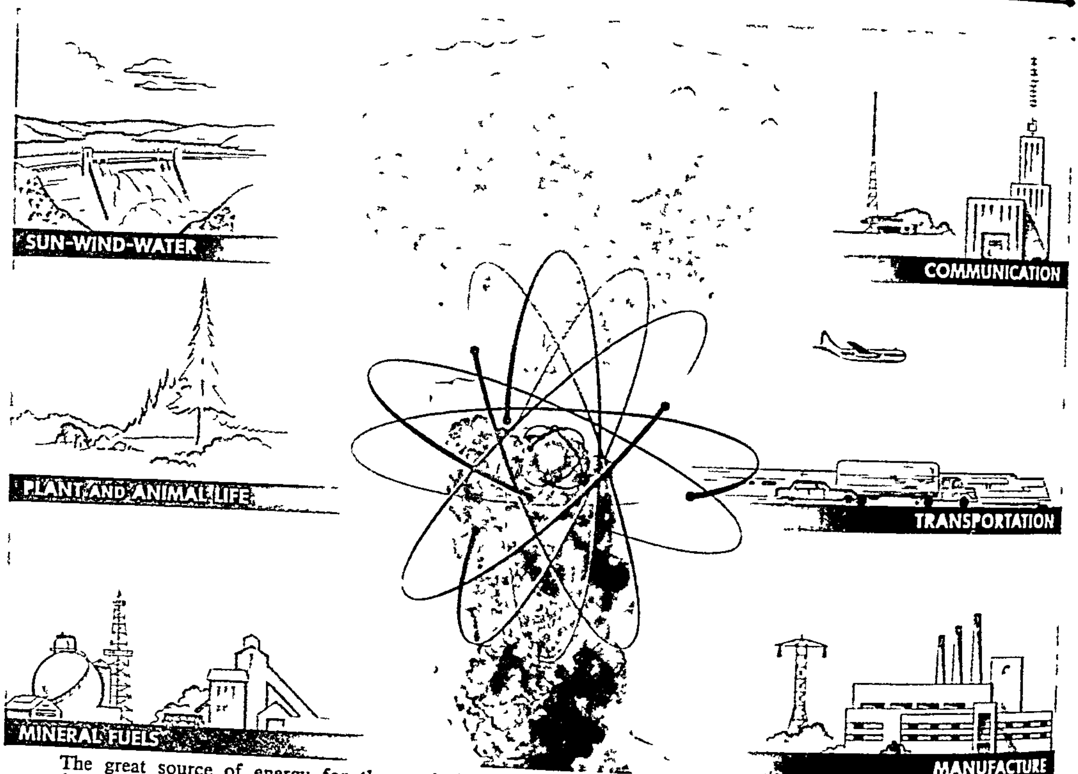
After the ingredients are mixed they are melted to a liquid glassy mass which is poured into cold water. This quenching shatters the whole mass into millions of tiny fragments called *frit*. The frit is then ground with clay, water, coloring material, and other ingredients. The product is a creamy liquid known as slip. Articles to be enameled are cleaned and dipped into the slip, or the slip may be applied to them by spraying. After they are dried (supported on metal points), they may be stenciled or colored by other means Finally the articles are fired in a kiln. For most enamelware further coats of slip are applied and the piece refired. In a variant of the process, dry-ground frit is applied directly to the piece as it comes from the kiln, while the enamel is still hot and plastic. *Agateware* and *graniteware* are trade names for varieties of enamelware.

Distinct from true enamel are the so-called "brushing enamels" and "automobile enamels." The first are glossy pigmented varnishes (*see* Paints). The second are synthetic lacquers (*see* Lacquer).

AN ANCIENT PIECE OF CLOISONNÉ

This ancient plaque shows clearly how cloisonné enameling is made. Metal ridges are set up, and enamel is applied in patches between the ribs. In later work, such as the Japanese vase on the next page, the ridges are almost too fine to be seen.

The th ee spe mens of enameling above show the varied beauty whi h may be ob ained by this p o ess—p tu es com p ex lines and figures and ornamen ed fla surfa es The p atte s a beautiful treatmen of The Last Supper done n pain ed ename on a coppe base by the F en h art s Jean Reymond in the se ond half o the 6 h century The jar s a modern spe men of Japanese c sonné wo k whi e he wine pot w th the hand e s of ename ed coppe The d sh and the wine pot are in the South Kensington Museum London and the jar in the Metropolitan Museum of Art n New Yo k



The great source of energy for the earth is the sun. It raises water into clouds, and later the water falls as rain or snow. If a dam sends the water through a turbine, the water generates electric power. This power is used in countless ways; but each use is just another transformation of energy from the sun.

ENERGY—*Its* SOURCES *and* ACTIONS *in the* UNIVERSE

ENERGY. A quick look about us shows events taking place in the physical universe—and behind or within each action something *makes* the action occur. Every day we see things happen because of heat and light from the sun and the driving power from the wind. When we burn coal in a furnace, it heats the air in our homes. Electric current sets filaments in light bulbs to glowing and thus gives us light. Gasoline makes our automobiles go. Food gives our bodies new strength and builds or renews tissues.

Science calls everything that "makes something happen" a form of energy; and any physical change in the universe or in our bodies requires some one of these forms to act. Without them, nothing could happen; no life could exist.

Where Do We Get Our Energy?

Almost all the energy we use has come to us from the sun. The white-hot sun emits radiant energy in all directions. Part of the energy is visible as sunlight. Much energy also is emitted both as ultraviolet and infrared (heat radiation).

On the earth, radiant energy from the sun changes into other forms. Some forms become heat, and unequal heating of the earth's surface creates winds. Some of the sun's rays evaporate water, which forms clouds. Later this water may fall as rain or snow. The water may be stored behind great dams and its potential energy used to generate electrical energy.

Radiant energy is used by plants to convert carbon dioxide and water into food by the process called photosynthesis. Plants and animals through plants depend upon this food. All common fuels are stored energy from the sun. Certain kinds of living organisms were buried deep under the ground ages ago and have been converted into coal and oil. (*See also* Sun)

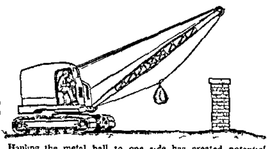
Working Aspects of Energy

Whenever energy is active, it *makes a change of some kind in matter*. Therefore science defines energy as the *ability to do work*, such as producing motion, heat, or chemical change in matter.

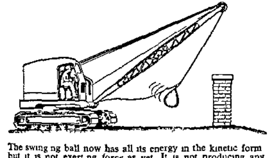
At any given time, a form of energy may be lying quietly, ready to produce changes when unleashed, or it may be in motion. Energy lying in motionless readiness is called *potential energy*. A coiled spring or a boulder in a position to roll down a hillside has potential energy. So likewise does food on a shelf. Once the food is consumed and digested, the body uses it for building new tissue and for providing energy to do work such as spading a garden or kicking a football.

Energy of motion is called *kinetic energy*. The kinetic energy of a moving hammer does the work in

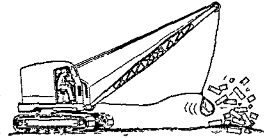
USING ENERGY TO DO WORK



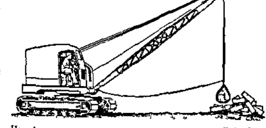
Hauling the metal ball to one side has created *potential energy* (energy of position) When the ball is released it will start swinging As it swings it transforms potential energy into *kinetic energy* (energy of motion)



The swinging ball now has all its energy in the kinetic form but it is not exerting *force* as yet It is not producing any effect upon matter (unless we count trifling effects produced upon the air and in the swinging cable)



The ball is exerting *force* against the wall Kinetic energy is being converted to *work* moving a weight of material in the portion toppled over and breaking up the masonry bonds which held the bricks and stones of the wall together



Here is *work done* shown by the amount of wall broken down and by the effects produced in the material itself The ball is hanging idle ready to receive renewed potential energy when it is hauled back to deliver another blow

driving a nail so does the kinetic energy of steam driving a turbine As an automobile climbs a slope potential energy stored ages ago in the earth as petroleum becomes kinetic energy in the engine and does the work in driving the car uphill At the top the automobile has potential energy It can roll down the other side without help from the engine Again this transforms potential energy into kinetic energy (*See also* Mechanics)

Even if the driver uses the engine it requires less gas because the rolling helps to move the car If the car goes too fast the driver steps on the brake The brake reduces speed by applying friction and friction changes some of the energy of motion into *heat* another form of energy

Physicists distinguish energy carefully from *work* Energy is *capacity for doing work* Work is something done the measure of what has been accomplished Physicists define the work done by a *force* as the product of the force exerted and the distance moved in the direction of the force If there is no motion there is no work A chair may hold a person up against the downward pull of gravity but in physics this is not considered work Accompanying pictures give a simple example of potential and kinetic energy with a heavy swinging weight demolishing a wall

How Molecular Motions Give Heat

This example shows *mechanical* kinetic energy in connection with the motion of large pieces of matter Motion of a different sort gives us another universally distributed form of energy heat This kind of motion occurs *within* pieces of matter even when the body of matter as a whole is at rest

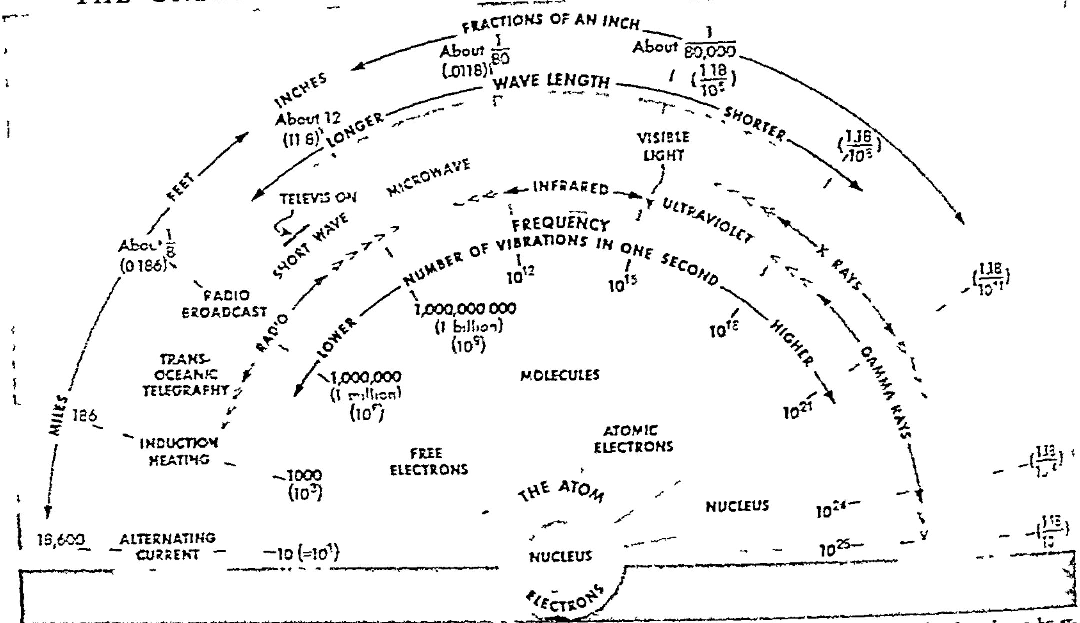
As explained in the article Heat heat *consists of motion* within the molecular structure of matter Even when a bit of matter is at rest the billions of molecules in it are in ceaseless motion Even in air that seems motionless the individual molecules are dashing about at speeds of roughly 1 000 miles an hour Every portion of matter has energy because of these motions and this energy is called heat

One way heat is produced is when moving masses are in contact and generate *friction* When friction opposes the motion of a body the work done to overcome the friction accelerates the motion of the molecules in that body that is it appears as heat If anyone slides down a rope too fast the heat generated may burn his hands (*See* Friction)

Matter can gain or lose heat in many ways Such changes will occur at points of contact between masses of matter which have different temperatures —that is different average energies of molecular motion In such situations the more energetic molecules share their excess energy with the others until all have the same average energy This kind of transfer is called *conduction*

A mass of molecules having considerable thermal motion (heat) can also be moved bodily from one place to another where the amount of heat in the surroundings is less A good example is heated water rising

THE GREAT SPECTRUM OF ELECTROMAGNETIC RADIATIONS



Here are the radiations which cross space as vibrations. The slowest vibrations, caused by alternating electric current, are at the left, and the tremendously rapid vibrations of gamma rays are at the right Vibration rates, or *frequencies*, are indicated by multiples (or "powers") of 10. Up to one billion, the actual numbers are shown and named The number of zeros in each is also shown by exponents (10^3 for 1,000; 10^6 for 1,000,000, and so on) Corresponding wave lengths (outside edge of the curve) shorten as frequencies become higher. The wave lengths (and frequencies) of many forms of radiation overlap as shown by shading and as explained in the article.

in a pipe to heat a building (*see* Heating and Ventilating). This kind of transfer is called *convection.*

Still another way of transferring heat is by electromagnetic radiation. Hot bodies emit light, infrared, and other kinds of rays (radiation). When these rays strike matter and are absorbed, they stimulate the molecules and produce heat.

Electromagnetic Forms of Energy

Electromagnetic radiation is distinguished by its ability to travel in wavelike forms across empty space, even from unbelievably distant stars and galaxies (*see* Astronomy). It is emitted and absorbed by matter. and when absorbed it creates various characteristic effects. It is called "electromagnetic" because the radiations are set up by moving electric charges and cause electric and magnetic effects.

All forms of electromagnetic radiation travel across empty space (that is. through a vacuum) at the same speed, about 186,000 miles a second. This speed is always equal to the number of vibrations a second, or *frequency*, multiplied by the *wave length* of the radiation (since both multiplied together must always equal the speed).

Either frequency or wave length can be used to identify any particular radiation. Physicists often use frequency, however, because the amount of energy carried by each unit portion of the radiation always increases in direct proportion to the frequency; that is, higher frequencies carry more energy for each unit of radiation.

A striking fact about electromagnetic radiation is the enormous range of frequencies, from a few oscillations a second (in radiations from alternating current machinery) to more than a thousand billion billion (10^{21}) a second for gamma rays. Even higher rates are found in *secondary cosmic rays*. These arise when *primary cosmic rays*, which are particles carrying fantastically high energy, arrive from outer space and interact with atoms in upper portions of the earth's atmosphere. The wave lengths range oppositely, from thousands of miles down to waves so short that more than many trillion would be required to measure one inch.

The Electromagnetic Spectrum

The entire array of radiations, from those of lowest frequency to highest (or longest wave lengths to shortest), is often called the *electromagnetic spectrum*. The term is adapted from the word "spectrum" for the radiations which carry visible light (*see* Spectrum). The various kinds of radiation are explained in the article on Radiation and in articles on each kind of radiation, such as Light.

The diagram at the top of the page shows various kinds of radiation overlapping. The radiations overlap because the various kinds were named in days when testing devices were less sensitive than modern ones, and physicists detected radiations (except those of visible light) only in the mid-portions of the ranges shown in the diagram. As a result it seemed likely that the kinds of radiations would be clearly separated

from each other at certain dividing wave lengths (or frequencies) It seemed likely also that each kind arose in its range from some characteristic interaction between energy and particles of matter

Radio waves, for example, were seen to occur when free electrons were set to oscillating in properly designed transmitting circuits, and the waves set up matching oscillations in receiving circuits This kind of radiation seemed clearly separated from infrared (radiant heat) Infrared was seen to arise from much more rapid vibrations (at correspondingly shorter wave lengths) and rotations of molecules Visible light and ultraviolet came from electrons within atoms and X rays arose when high-speed electrons struck matter Gamma rays were radiated when the particles in a nucleus were rearranged

Today scientists have much more delicate testing devices and they can also use tremendously greater amounts of energy in experiments As a result they can produce infrared wave lengths with radiolike circuits and produce X rays which have a higher frequency than the gamma rays from most nuclei

Thus the older divisions of radiations have blurred together," and the names no longer correspond clearly to separate kinds of radiation and separate sources Today the only sure way to identify a radiation precisely is to state its frequency or wave length The one exception to the blurring is visible light This is because we see light through extremely delicate nerve endings in the eyes and these respond only to relatively sharp bands of frequencies (or wave lengths) in registering energy as different colors of light

Absorption and Emission of Radiation

The different radiations will either be *transmitted* (that is pass through matter) be *reflected* or be *absorbed* according to the kind of radiation and kind of matter When matter transmits radiation (as glass or water does with light) the frequency remains unchanged but the speed and wave lengths in the matter are reduced in various amounts

When matter absorbs radiation, some of the energy produces heat The heating may be slight or it may be virtually the entire effect as happens when infrared rays are absorbed Part of the energy is reradiated (emitted) in some form

The emitted energy may differ in various ways from that which was absorbed In some cases the emitted ray simply goes in a different direction Often substances absorb light of a certain frequency and "color" and emit light of a lower frequency and different color' This is called *fluorescence* Sometimes the energy of the light rays is captured by an electron, and the electron is expelled from the atom or material to which it was attached This is called the *photoelectric* effect

All bodies emit radiation, but the amount and the quality of the radiation depend on the temperature of the emitting substance For example, if a piece of iron is moderately hot it emits infrared rays which our eyes cannot see If the iron is heated to about 1,300° F, it continues to radiate infrared rays, but it

UNITS USED FOR MEASURING ENERGY

Unit	Used for	Value in Foot-Pounds
Kilowatt-hour (kw hr)	Electric energy	2 655 000
Large calorie or kilocalorie	Food	3 087
Small calorie	Used in chemistry physics	3 087
British thermal unit (B T U)	Heat furnaces and air coolers	778
Erg	Mechanics physics	0 00000007376 $(7\ 376\times10^{-8})$
Joule		0 7376 (10 mill on ergs)
Atomic mass unit (a m u)	Nuclear physics	0 00000000011 (11×10^{-11})
Electron volt (ev)	Nuclear physics electronics	$1\ 18\times10^{-19}$

The basic unit for measuring mechanical energy in the English system is the foot pound This is the energy required to lift a one pound weight one foot straight up All other units can be expressed in these terms as shown above

also emits radiation of a frequency which we see as dull red light

When the iron commences to emit visible light it is said to be *incandescent* If it gets enough heat to attain higher and higher temperature the color changes to cherry red then orange If the iron becomes hot enough it emits all the colors of the visible spectrum and the mixture of colors is seen as white In this condition the iron is said to be ' white hot " and ultraviolet rays are emitted as well as visible light and infrared rays

The ball of fire' in an atomic bomb explosion may have a temperature of half a million degrees From it come X rays and gamma rays as well as ultraviolet rays blinding visible light and intense infrared radiation together with fragments of matter

Forms of Electrical Energy

Some kinds of matter, particularly metals contain free electrons If these electrons are set surging through the matter they constitute electric current Electric current is easy to control and we use it in countless ways Large electric motors drive many of our trains Electric energy gives us lighting and heating, power for factories and carries our voices over telephones (*See also* Electricity)

When electric currents are made to surge back and forth a million times a second in an antenna radio waves are produced These waves are also of the same fundamental nature as light but the waves are longer than a city block Somewhat shorter electromagnetic waves are sent out by television stations and radar units (*See also* Radar, Radio, Television)

Chemical and Nuclear Energy

In many of the phenomena produced by applications of energy the matter involved is changed in *state* but not in kind Ice can change to water and then to

steam by gaining enough heat; the opposite changes occur as heat is lost. But throughout all these changes, each molecule of water remains water (H_2O).

In other cases, the *kind* of matter is changed. Steam passing through a mass of red-hot coal or coke in a suitable apparatus produces a manufactured gas called water gas (*see* Gas, Manufactured). The right combination of products obtained from coal, air, and ammonia produces nylon (*see* Nylon).

Such changes in kinds of matter involve *chemical energy*. Many chemical changes are produced by heat and electrical energy acting from outside the molecules. (*See* also Chemistry; Matter.)

Chemical energy produces effects with forces that act *between* atoms. A far more powerful type of energy produces interactions between the particles that make the *nuclei* of atoms. In reactions involving nuclear energy, part of the mass in the interacting particles may be transformed into forms of energy, just as Einstein predicted in 1905 (*see* Relativity). Thus mass must be considered a form of energy.

Conservation of Energy

Although one form of energy can be changed to another in countless ways, physicists have proved that *through all such changes, the amount of energy involved remains unchanged*. The energy is changed from one form to another, but it is not increased or diminished, created or destroyed. This is one of the most basic principles of all science. It is known as the Law of Conservation of Energy. (Today the law takes into account the energy associated with mass in nuclear reactions.)

Since one form of energy can be transferred into another, the units used for measuring the various forms can all be defined in the same terms. The table on the preceding page shows how this can be done in the English system, commonly used in American engineering. Most scientists prefer to use seconds and metric units such as centimeters and grams (the c.g.s. system) or kilograms and meters (the k.m.s. system)

Energy as a Commodity in Commerce

Energy is immensely important in economics and commerce. When we buy coal, fuel, oil, food, or gasoline, we are paying for energy. Each year the average American buys enough energy derived from coal, oil, natural gas, and hydroelectric sources to lift a 10,000-ton load to a height of two miles. Another large amount of energy is used as food for us and our animals.

The standard of living in a country is very closely related to the amount of energy which is available to the average person. Where living standards are low, people may have available only the energy provided by their food requirements. Where the standard of living is high, not only is there an abundance of food but there is energy to run all kinds of useful devices such as refrigerators and automobiles.

Modern Views about the Nature of Energy

SOME EFFECTS produced by energy upon larger masses of matter, such as mechanical motion and heating, can be explained without considering the "inner nature" of molecules and atoms. But effects produced by other forms, such as light, depend upon this "inner nature," because these forms of energy produce interactions with the particles (electrons, protons, and others) which make up the atoms.

These interactions occur in every atom between energy and either one of the atom's two parts—the atom's central core, or nucleus, and an outer portion containing from one to more than 90 electrons. Physicists have identified the characteristics in the various forms of energy which "fit in" with these tiny parts of atoms and cause them to react. The key to this knowledge is the so-called *quantum theory of energy*.

The Quantum Theory of Energy

Before 1900 physicists had thought of radiant energy as something that acted like waves in a fluid. According to this view, energy would spread out in ever-wider circles across space; and the energy moving along any line from a point of origin would "thin out" as the wave spread into wider and wider circles.

Between 1900 and 1905, however, physicists found examples of energy which did not work according to this theory. In these cases, atoms seemed to receive and emit energy in definite units, "packets," or corpuscles, or multiples of them. They would not react to any "indefinitely thinned out" amount of energy, such as would occur under the wave theory.

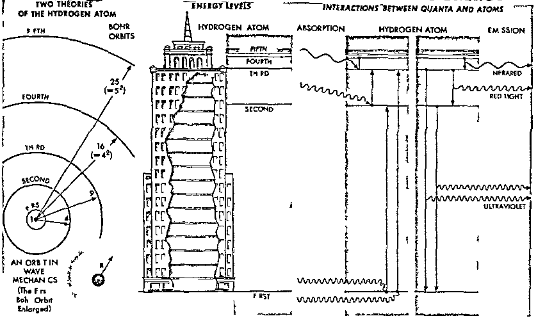
Max Planck found that he could explain the radiations emitted by hot bodies only by assuming that radiant energy was always absorbed and emitted in little chunks, which he called *quanta*. (A single chunk is a *quantum*.) Later, Einstein successfully explained the photoelectric effect by using these little bundles of energy, which he called *photons*. Both terms are used today.

The new theory, however, encountered one serious difficulty. Theories based on photons could not explain the behavior of light when it passed through narrow slits or bent around small obstacles. Not until physicists developed the new view further could they begin to understand why light behaved like a wave motion part of the time and acted like a stream of particles (photons) in other cases. This combination of views was developed about 1925 by the theoretical physicists De Broglie, Schrödinger, and others. It is known as *wave mechanics* or *quantum mechanics*. Electrons and other particles are shown to have wave properties, and the wave-particle theory applies to matter as well as to photons.

The Modern Theory of Wave Mechanics

The heart of the theory can be stated in highly simplified terms as follows: both the units of *matter* (atoms, and the electrons, protons, and other particles which make up atoms) and the units of radiant or electromagnetic energy (quanta, or photons) behave like particles which move through space as though controlled by wavelike patterns.

HOW THE HYDROGEN ATOM ABSORBS AND RADIATES ENERGY



Above (left) are the circular orbits which were allowed by the original Bohr theory. In modern theory the electron wanders freely, but usually it is near the position of the first Bohr orbit, as shown in the lower diagram.

The atom's electron has various amounts of energy, *according to the orbits it occupies—just as people can occupy* different floors in a building. But the *difference* in energy *between adjoining levels becomes less the farther the levels* are from the nucleus, as explained in the article. Thus the interval between energy levels is the opposite of that between Bohr orbits.

At the right, one diagram shows various upward jumps, as electrons (dots) receive photons (wavy lines) with *various amounts of energy. When the electron drops back* (as it will) from one level to another (far right), it radiates *energy according to the levels involved.*

A rough comparison can be made with swallows hunting insects in the air. The birds may be sitting motionless near their nests or on a wire. Suddenly the *whole flock* swoops away in wavelike *flight seeking* insects in the air. Each swallow remains an individual like the photons in the theory, but the flock as a whole moves *in waves which are controlled by the distribution of the insects.*

The theories of wave mechanics differ, however, from the example of the swallows in many ways. One difference is that the control which led the swallows into wavelike motion existed in space outside the birds, that is, in the distribution of insects in the air. On the other hand, the wave and particle natures of matter and of radiant energy do not have an independent existence. The waves originate where the *particles are and they travel outward as the particles move.*

Under this two-part theory, the wavelike patterns *show where energy will go when it is traveling across* space and when it encounters matter, as light does when it strikes mirrors, lenses and other optical devices. But when energy penetrates atoms and makes them react, the quantized energy chunks produce the reactions. Similarly, in electrical devices electrons act as particles. If a beam of electrons is sent through thin gold foil, however, the wave properties make the electrons show diffraction effects just like those shown by light and other kinds of wave motion in suitable experiments.

While the photons of radiant energy and the particles of matter (such as electrons, protons and atoms) all have properties which are wavelike and particlelike, they differ entirely in many ways. For example, an electron or an atom can be made to go fast or slow, while the speed of a photon in air is always the same. An atom can be slowed down and weighed; a photon cannot because it has no rest mass.

Variable Nature of Photons, or Quanta

Physicists realized from the very first theories about quanta that quanta, or photons, having different frequencies (and wave lengths) have different amounts of energy. In every case the energy is *directly proportional to the frequency, and all photons* of any one frequency have the same energy. Strength of radiation at any one frequency is determined only *by the number of photons acting. The energy at any* frequency can be found by multiplying the frequency by Planck's constant (usually indicated by the letter *h*). The energy in joules (work units) can be obtained by multiplying the frequency by 6.62 and dividing the product by 10^{34}. A photon of a given frequency cannot be subdivided. There can be one, or two, or ten, but *never four and a half.*

Planck's constant is unbelievably small and so is the energy obtained by multiplying Planck's constant by the frequency of a light quantum. For example, the energy in one photon of visible light is so tiny that it would take more than three billion billion of them to lift a pound weight one foot.

How Radiant Energy Affects Matter

The simplest examples of radiant energy interacting with matter are afforded by the hydrogen atom, because it has only one electron. In any kind of atom which has more than one electron, the electrons repel each other; and this fact makes interactions very difficult to trace.

In 1913 Niels Bohr proposed a structure for the hydrogen atom in which the electron goes around the nucleus in any of certain circular orbits that had certain "allowed" values for the radii of the orbits. The smallest (first) of these Bohr orbits had a diameter of about four billionths of an inch. The next had a diameter of 2^2 (or 4) times this. The diameter of the third allowed orbit was 3^2 (9) times that of the first, and the orbit for any number (n) is n^2 times as far across as the first one.

The idea that only "allowed" orbits could exist seemed strange to physicists at first, but many aspects of the world exist in levels. We find people only at certain levels in a skyscraper, and the positions of the various floors determine where people can be found. In atoms, conditions arising from the quantum theory determine the possible energies for the electrons and the corresponding orbits of the Bohr theory.

Bohr's Orbits in the Hydrogen Atom

The hydrogen electron is normally in the innermost orbit with $n=1$, because the attractive force between the positive proton and the negative electron pulls the electron into the smallest allowed radius. It takes energy to lift the electron farther from the proton, just as it takes energy to lift a weight farther from the center of the earth.

For each allowed radius the electron has a specific energy; the bigger the radius the higher the energy. But the *differences* between the energies of two consecutive orbits get smaller, because the attractive force between the proton and the electron gets smaller as the electron's distance from the nucleus becomes greater. In the accompanying diagram which shows the differences in the amounts of energy between adjoining orbits (or levels), the greatest difference will occur between the first and second orbits. Beyond this, the amount of energy between energy levels gets less and less, even though the orbits are farther and farther apart.

Bohr then assumed that whenever electromagnetic radiation such as infrared or light is absorbed or emitted, the atom's electron jumps from one orbit to some other one. When energy is absorbed, the jump is from an inner orbit outward, because the gain in energy allows the electron to pull farther from the nucleus. When an electron drops from an outer orbit inward, it radiates away the difference between its energies in the two levels. (The "jumps" and "drops" are explained in greater detail in the article on Matter.) The frequency of the radiation can be found by dividing the difference between energies in the two levels by Planck's constant h, and the wave length can be found from the frequency.

How Wave Mechanics Changed the Bohr Theory

Bohr's relatively simple theory explained most of the facts which were known about hydrogen atoms in 1913, but it has had to be modified as more facts were discovered. Further, Bohr's theory could not explain many of the energy levels in atoms which have more than one electron. The modern wave mechanics theory can explain many things about complicated atoms; and it modifies even Bohr's theories about the hydrogen atom.

One change is replacement of the "point" electron by a more elusive and "fuzzy" electron. The idea of sharply defined orbits has been abandoned. An electron of a given energy may be found at any distance from the nucleus instead of only at a distance corresponding to some Bohr orbit. The *most likely* distance for the electron, however, is just what the Bohr theory predicted as the *only possible distance* for the given amount of energy. Although the electrons themselves and their orbits lose their exact positions in wave mechanics, the energy levels remain sharp; and the allowed energies for the electron are essentially identical in both theories.

The theory of energy levels enabled physicists to explain the spectra emitted by atoms of various kinds —that is, the "light" emitted by the atoms because of electrons jumping from one level to another (see Spectrum). Energy levels are important also in understanding radiations such as infrared, which are emitted by rotating and vibrating molecules.

Mass and Energy within Atomic Nuclei

The theories of wave mechanics were needed also to explain the rapidly growing knowledge concerning interactions between energy and atomic nuclei. Nuclear forces are vastly greater than those between atoms or the forces which hold electrons in their energy levels within atoms. Consequently, the energy required to change a nucleus from one energy level to another is relatively tremendous.

The exact nature of the forces which hold nuclei together is not known; but they cannot be electrical. The only parts of a nucleus which normally show electrical characteristics are positively charged protons. These would fly apart unless held together by some superior nonelectrical force.

In 1905 Albert Einstein published studies which seemed to prove that in certain circumstances mass and energy can be changed, one into the other. When a mass (m) is changed to energy (E), according to Einstein's theory, the amount of energy is stated by the equation $E=mc^2$, where c is the speed of light in a vacuum. Since this is a huge number, a very tiny amount of mass is equivalent to a tremendous amount of energy. The disappearance of one millionth of a pound of mass gives enough energy to lift a million

tons of matter 150 feet straight up (*See* Atoms, section "Atomic Power", Relativity)

Not only may mass be converted into energy, but energy can be changed to mass When an electron is accelerated in a synchrotron to an energy of 300 million electron volts (Mev), its mass increases to 600 times its mass when it is at rest Another conversion occurs when high-energy X rays or gamma rays strike a nucleus The nucleus emits matter—a positron and an electron This is called pair production, and the pair comes from the absorbed energy, since the mass of the nucleus remains unchanged

When protons and neutrons join to form stable nuclei vast amounts of energy are released The hydrogen bomb gets its energy from the joining together of hydrogen nuclei to form helium nuclei Nuclear energy can also be released when large unstable nuclei break up into smaller and more tightly bound ones This is what happens in the fission bomb in which uranium atoms break up In an atomic bomb about one thousandth of a pound of matter disappears for every pound of uranium 235 which breaks it up

The sun maintains its outpouring of energy by a series of nuclear transformations which release free energy by transforming hydrogen nuclei (protons) into heavier nuclei, such as helium The reaction is similar to that of the hydrogen bomb, except that different forms of hydrogen are used The sun's mass is approximately half hydrogen in one year about one billionth of one per cent of the sun's hydrogen is used up Therefore the sun can continue to pour out energy for many billions of years before it consumes its hydrogen

Engineering The skilled engineer of today is not only a builder, he is an expert who can solve the most intricate economic and financial problems and can forecast the future Thus, an engineer locating a railway line can tell what route will yield the largest earnings through his knowledge of the effect of grade and curvature on the cost of haulage and other such details Before the United States started work on the Panama Canal—the greatest engineering achievement in history—engineers estimated that the cost of digging 100 000 000 cubic yards of rock from the Culebra cut would be 80 cents a yard When the canal was completed some 15 years later, it was found that they had overestimated by less than two cents a yard

The increasing complexity of industry makes the expert engineer more and more a necessary factor not only in industry but in governmental supervision of industry The United States Interstate Commerce Commission employed hundreds of engineers to value the country's railways State public utilities commissions often employ scores of engineers Enormous projects requiring the services of big engineering staffs for five or ten years are sometimes necessary to supply a great city with water

The present tendency is for industrial engineering to concentrate in the hands of large firms employing many engineers Probably 95 per cent of American engineers work on a salary, either for commercial firms or in city state, or federal service In the work of the engineer is included the design and planning of the engineering project and the supervision of the carrying out of the work In some cases the engineers contract for the construction of the work An engineer who gives advice as an expert on engineering work is termed a "consulting engineer" Since a consulting engineer is frequently asked to advise on the work of other engineers, he is generally a man who has had considerable experience in his field

There are four principal divisions of engineering civil, electrical mechanical and mining engineering *Civil* engineering comprises works in connection with transportation, such as railways, canals and roads, works which have to do with water, such as public water supply, irrigation drainage, and sewerage, works of river and harbor improvement, and structural works such as bridges buildings, dams, piers, docks, and so forth *Electrical* engineering deals with the design, construction and application of electrical machinery and apparatus *Mechanical* engineering is the art of machinery design and construction Mechanical engineering underlies engineering of every class and all kinds of industrial operations to such an extent that it can almost be said to support the whole fabric of modern civilization *Mining* engineering includes the work in connection with the exploration for mines and their development The highest professional skill is required to examine and report on the value of a mine and its probable life

Each of these divisions includes a large and increasing number of specialized lines, totaling 100 or more Thus, civil engineering includes railway, hydraulic structural, sanitary engineering, and so forth Mechanical engineering includes steam, gas, automobile, aeronautical, and heating and ventilating engineering Many distinguished engineers, however, do not specialize at all but act as technical executives, directing the work of various engineers to complete a great construction work or to conduct a huge manufacturing or mining industry

Other engineering fields are also important *Chemical* engineering is the adaptation of the science of chemistry to industrial uses, including the building and operating of chemical plants *Ceramic* engineering deals with the manufacture of products from such nonmetallic substances as sand and clay *Marine* engineering includes all phases of shipbuilding *Military* engineering includes the building of camps, bridges, roads, and fortifications and the installation of communication and radar systems

Among the most notable engineering works of remote antiquity are the Pyramids of Egypt (*see* Architecture, Pyramids) The Hanging Gardens of Babylon were one of the wonders of the world, and the harbors and temples of ancient Greece testify to no little engineering skill The theaters, temples baths, aqueducts, roads bridges and drainage works of ancient Rome vie in extent and magnificence with many celebrated modern works Other engineering

feats of former days are the Dutch canals and embankments for inland navigation and for protecting the low lands from the sea, and the cathedrals and castles of medieval Europe.

Notwithstanding the large number of students of engineering in our colleges, the demand for technically trained men is so large and so varied and so many new fields of technical work are being opened that few competent engineers fail to find profitable employment. For one who likes mechanical and construction work and has a taste for mathematics and physics, engineering offers a fine field for attainment and service to mankind. Energy, sound practical judgment, and a painstaking accurate temperament are essential. For the degree of C.E. (Civil Engineer) or M E. (Mechanical Engineer) most technical and engineering schools of repute require four years of undergraduate work, about three years of successful experience, and one year of graduate work. One can scarcely hope to be trusted with planning and supervising important engineering works before he reaches maturity and has years of technical study and practical experience.

The STORY *of* ENGLAND, *Its* LAND *and* PEOPLE

White chalk cliffs, 700 or 800 feet high, frame the southeast coast of England. On clear days they can be seen from France, across the Strait of Dover.

ENGLAND. The largest of the British Isles has been home to three historic nations—England, Scotland, and Wales. Today these nations, together with Northern Ireland, make up the political unit called the United Kingdom of Great Britain and Northern Ireland. And today England, as always, is the leader of the three.

England has an importance in history all out of proportion to its size. The English people built up the greatest empire the world has ever known. They took the lead in the gigantic development of commerce and industry that created machine-age civilization. English explorers, missionaries, traders, and emigrants spread the English language and ideas around the earth. British colonies retained the stamp the English had given them, whether they left the empire or remained within it. The culture of the United States was built largely on English foundations—English speech, common law, and our English principles of religious and political freedom.

No Part of England Is Far from the Sea

England is roughly triangular in shape. Draw straight lines around it on the map and the southern base will measure about 315 miles across, while the east and west sides will be about 350 miles each. But a trip around the coast, winding around headlands and sailing into bays and inlets, would come to about 2,000 miles. So deep are the indentations that no point in England is more than 75 miles from salt water. To the east England faces the shallow North Sea, and to the west the Irish Sea and St. George's Channel. To the south it looks out over the English Channel to the coast of France. Only at the extreme southwest tip of the triangle does it face the open Atlantic Ocean.

Such a location and coast line invited the English to seek their fortunes at sea. They obeyed the call and became the world's greatest sea power and the leading traders by sea. English ships are found in all the large ports of the world. They carry goods not only for British needs, but for other nations as well

Divisions of the English Land

The Cheviot Hills separate England from Scotland. From these highlands the Pennine Chain reaches down like a finger to the center of England. In the northwest corner, tucked in between the Pennines and the sea, are the Cumbrian Mountains. This region is England's beautiful mountain playground. It is called the Lake District from its many small, charming lakes.

Extent.—North to south, 354 miles; east to west, 315 miles. Area, 50 874 square miles. Population (1951 census, preliminary), 41 572,585

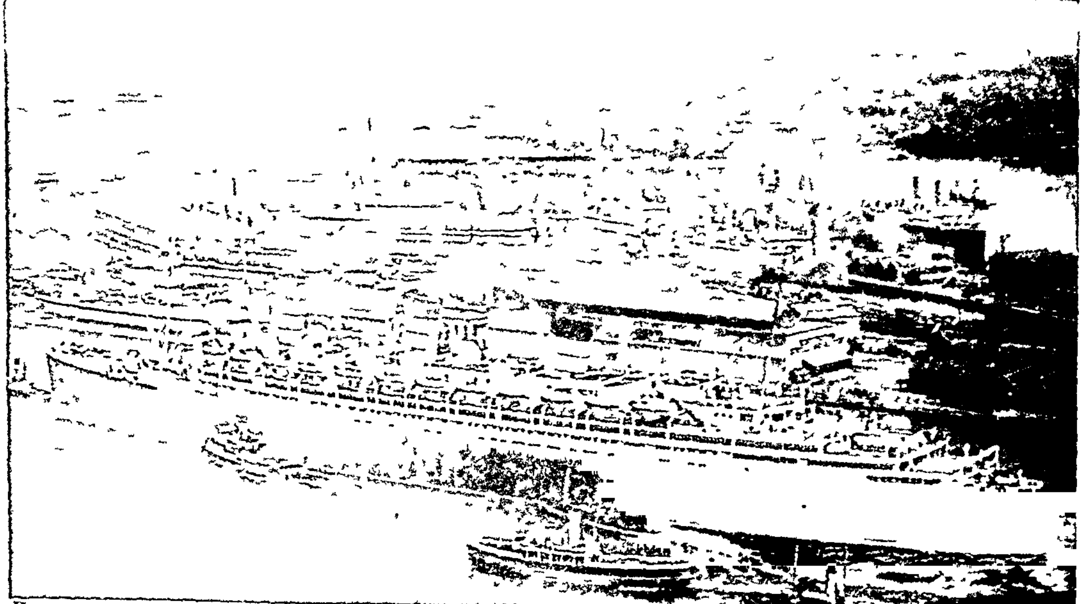
Natural Features—Low rolling country, broken by the Pennine Chain in the north; the Cumbrian Mountains in the northwest (highest point, Sca Fell, 3 210 feet), the Downs in the southeast and Devon hills in the southwest. Principal rivers Severn, Thames, Humber, Mersey, Tyne. Climate, mild with little variation.

Products—Wheat, barley, oats, hay and forage crops, hops, fruit, potatoes, turnips, cabbage, sugar beets; cattle, sheep, hogs, horses, dairy products, herring, haddock, cod, and other fish; coal, iron, granite, limestone, and clay; iron and steel manufactures, textiles, clothing, pottery, ships and boats.

Cities.—London (population of Greater London, 8,346 137); Birmingham (1,112 340), Liverpool, Manchester, Sheffield, Leeds (over 500 000); Bristol (over 400 000); Nottingham, Kingston-upon-Hull, Bradford, Newcastle-upon-Tyne, Leicester, Stoke-on-Trent, Coventry (over 250,000).

Many of the English counties (shires) are older than England itself for they existed as old tribal kingdoms before the central government was established Essex Sussex and Middlesex were the kingdoms of the East South and Middle Saxons Norfolk and Suffolk took their names from the North Folk and South Folk of the Scandinavian invasion Other counties were named after fortified towns Thus Derby was the nucleus of Derbyshire and Oxford of Oxfordshire.

ENGLAND'S GREAT PORT FOR FAST LINERS



Here are the vast docks of Southampton, the busiest seaport on the English Channel. The passenger liner in the foreground is the *Queen Mary*. It and many others begin and end voyages here rather than at London to save time.

Here rises the highest peak in England, Sca Fell (3,210 feet). Grass covers the lower slopes of the highlands. Monotonous *moors*—wastelands covered with peat bogs, moss, and wiry heather—clothe the summits. Rich coal fields spread out from the Pennines on the east, west, and south.

The heart of England is a rolling grassy plain called the Midlands. The rugged highlands of Wales bound the Midlands on the west. In the east it merges into a coastal plain that bulges out toward the Netherlands. This bulge, called East Anglia, is almost Dutch in appearance—low, flat, and marshy. The northern part of the plain, the Fens, has been reclaimed by drainage from marsh and sea.

Granite and Chalk in the South

The Thames River marks off the Midlands from the extreme south of England. The long southern coast line provides a variety of scenery. In the southwest peninsula (Devon and Cornwall) jagged granite masses break up the coast into headlands, with many little bays cut back into limestone or sandstone. Inland are grassy valleys, heather-covered moors, and high granite hills called *tors*. Farther east lush green valleys mingle with wastelands (*heaths*) covered with heather and prickly gorse.

Close to the center of the south coast lies the beautiful green Isle of Wight (*see* Wight, Isle of). Rounded hills of chalk—the Downs—cover the land in the southeast. Away from the coast they are clothed with grass and capped with trees. Along the shore they present high white cliffs to the sea.

The mountainous backbone of England is in the west. Most of the rivers, therefore, flow down the gentle slope to the east. In the northeast are the short Tyne and Tees and the wide Humber, formed by the junction of the Ouse and Trent rivers. The famous Thames flows across southern England to the North Sea (*see* Thames River). The chief rivers in the west are the Mersey and the Severn. The Severn is the longest river in England. It rises in Wales, curves around to the east and south, then widens into the Bristol Channel.

A Typically Marine Climate

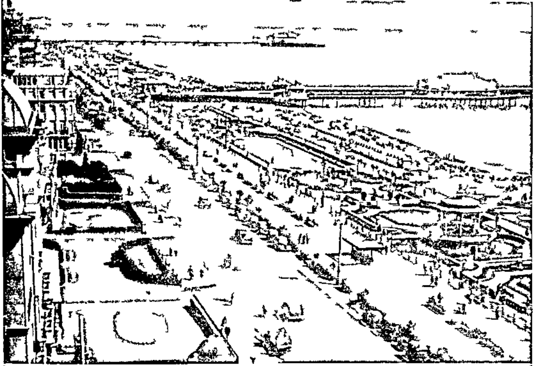
England has cool summers and mild winters. It lies as far north as Labrador; yet snow and crisp cold are rare. Grass stays green throughout the year, and roses bloom in English gardens until December. Winter temperatures average 35° to 40° F. From winter to summer the temperature rises on the average less than 25 degrees. The island owes its mild winters to the westerly winds that blow over it from the warm water of the North Atlantic Drift, a continuation of the Gulf Stream (*see* Gulf Stream).

Rain falls in frequent drizzles throughout the year. Fogs are frequent, particularly in winter. Spring is the sunniest season. The west coast has the heaviest rainfall, about 40 inches a year. The plains in the east and southeast have about 20 inches.

Character of the English People

Up to the 11th century England suffered many invasions (*see* English History). The present population, therefore, is a fusion of various European stocks. The invaders were chiefly blond, long-headed peoples—Saxons, Angles, Norse, Danes, and Normans. Century after century they pushed the older inhabitants, the dark-haired Celts, into Wales and north Scotland. The population today is, therefore, predominantly the blond, long-headed type.

TWO OF ENGLAND'S FAVORITE OUTDOOR AMUSEMENTS



England's largest and most famous seaside resort is Brighton on the English Channel 50 miles south of London The upper picture shows the broad Esplanade bordered by fine hotels and shops In the lower picture members of a hunt are gathered in front of a country house Soon the riders will streak off across the green countryside following the yelping hounds.

The English have a love for their past that causes them to hold fast to their ancient traditions. They have long been accustomed to democratic government and political freedom. Yet they continue to regard the royal family with affection and reverence.

The English Are a Sporting People

Englishmen of all classes are enthusiastic about sports. They play golf and lawn tennis (on real lawns), and they box, row, ride, hunt, and fish. The large landowners retain shooting rights over the land they rent to farmers. They shoot partridges, pheasants, and hares. "Hunting men" ride to the hounds in pursuit of a fox.

The most popular games in England are cricket in summer and football (soccer or rugby) in winter. Soccer championship games draw great crowds to huge stadiums. Rugby ("rugger") is mainly an amateur sport. Cricket is as popular in England as baseball is in the United States. It is played in schools, by amateur clubs, in the villages, and in professional matches. The very word cricket has come to mean "fair play" in ordinary life. A dishonorable business deal is condemned as "not cricket." (*See* Football; Cricket.)

English and Americans speak the same language; but many of the words differ. To an Englishman a druggist is a chemist; a drygoods store is a draper's shop; a candy store is a sweets shop; and a hardware store is an ironmonger's. Corn is maize and wheat is corn. A cookie is a biscuit, squash is marrow, and syrup is treacle. A truck is a lorry, gasoline is petrol, a freight car is a goods wagon, and baggage is luggage. A legal holiday is a bank holiday. Radio is wireless. Checkers are draughts. Movies are flicks, and the theater where they are shown is a cinema.

Each county has its own distinctive dialect and its own names for things. A native of Cornwall can hardly understand a native of Yorkshire or Northumberland. A narrow ravine leading to the sea is called a *coomb* in Cornwall and Devon, a *chine* in Hampshire, and a *dale* in Yorkshire. The preferred speech of England is the Oxford accent. At the other end of the scale is the pronunciation of the cockneys in London's slums.

A Nation of City Dwellers

More than any other people, the English are city dwellers. Four out of five live in urban areas. About 10 million—a quarter of the total population—live in London and its suburbs. Another 10 million live within a 50-mile radius of Manchester, in the heart of the Midlands. This great manufacturing district—so smoky it is called the Black Country—is practically a continuous city. Great ports, fishing villages, and seaside resorts line the coasts. Even Green England (the south and east) is dotted with good-sized towns. The highland regions alone are sparsely settled. With the single exception of the Netherlands, England (with Wales) is the most densely populated country in Europe.

Perhaps because the English live on a crowded island, an Englishman guards his privacy carefully and respects the privacy of others. He will travel all day on a train without speaking to anyone. His reserved manner often makes him appear haughty to Americans. But he is usually courteous and soft-spoken and tolerant of another's opinion. He dislikes bragging and showing off and finds little humor in American "tall tales." The typical English joke depends on *understatement*. A violent storm is "a bit of a blow."

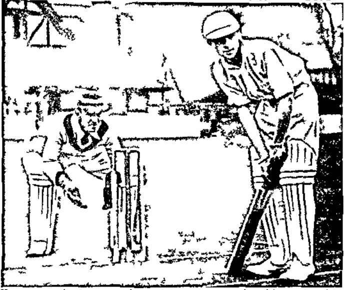
FLOWERING HEDGES MAKE FENCES FOR FIELDS AND PASTURES

Ancient hedges of hazel and hawthorn add to the charm of the countryside in the south of England. This picture shows the rugged tableland of Dartmoor, on the coast of Devon. Here plowed fields and lush meadows alternate with level wastelands, called *heaths*, and picturesque granite heights, called *tors*.

An ever-increasing number of working people live in blocks of flats (apartment houses) Miles of ribbon dwellings (houses touching one another in long rows) spread out from the cities Other houses are semi-detached that is they touch the next-door house on one side only But the city worker much prefers a one-family house A London clerk will travel far out into the suburbs to have his own front door and his own garden Rooms are ordinarily heated by coal burned in open fireplaces or by gas grates

Breakfast is a full meal Bacon and eggs are not so plentiful as they once were but there is always toast marmalade and tea and often kippers (smoked herring) Between lunch and dinner practically every one even office workers stops for tea. For this meal cakes and scones (hot sweet bread) are usually served or in more old fashioned homes crumpets (soft unsweetened muffins) For the workman a large tea is the evening meal On Sunday he may have a joint (roast) with potatoes and cabbage or turnips

CRICKET IS ENGLAND S NATIONAL SPORT



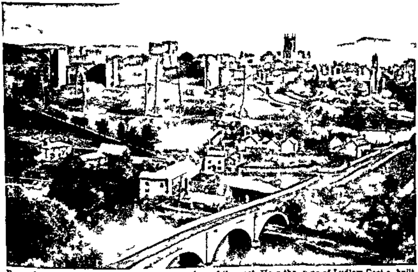
He e a e a w cke keepe cat he a batman ba e and a wicke w h upright *stumps* and *ba ls* a oss the top The art cle on C ket tells how the ba ter h s runs and s pu out

The cinema is the main entertainment in the towns The workman spends many evenings at his favorite pub, the *poor man s club*. Here he takes light beer (he calls it bitters) and discusses sports and politics The family s idea of a holiday is a stay at the seaside People go to the seaside not only for their vacations but over the long week ends of the summer bank holidays—Whitmonday (following the seventh Sunday after Easter) and August Bank Holiday (first Monday in August) Usually they do not stay at hotels but go into lodgings with a private family

The English Countryside

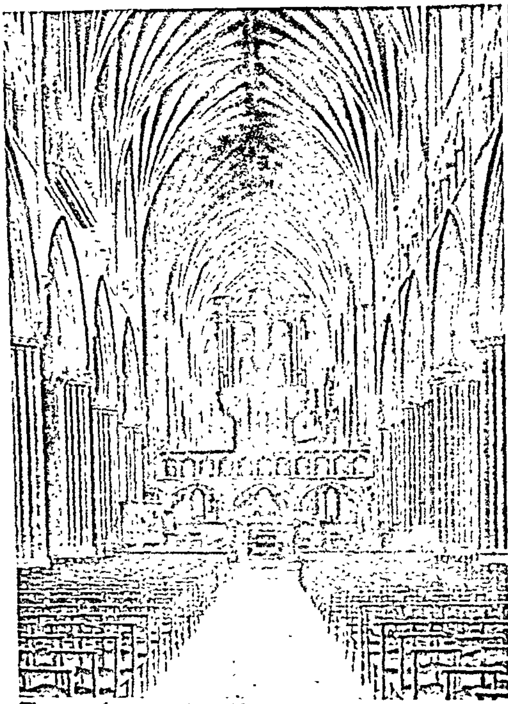
Though he must live in the city the Englishman is still at heart a countryman On Sunday afternoons when the weather is fine he goes to the country for an outing Even a short journey affords a variety of scenery Each county is like a different state and often the scenery changes in short distances

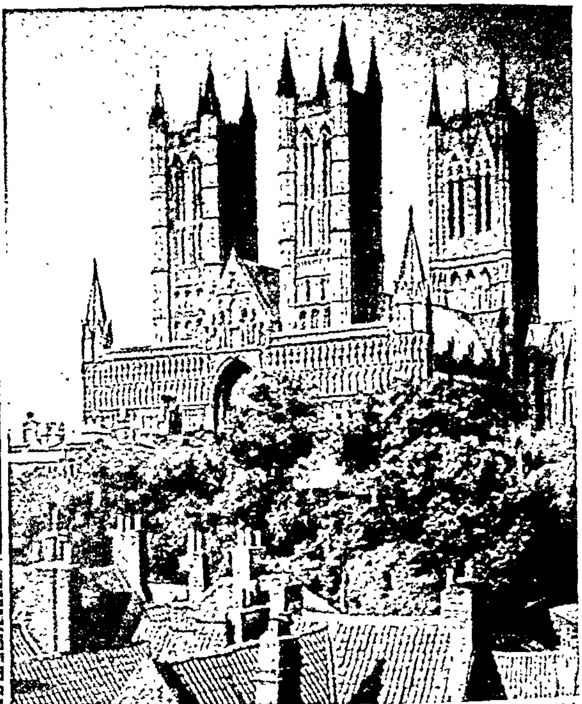
A REMINDER OF THE MIDDLE AGES IN MODERN ENGLAND



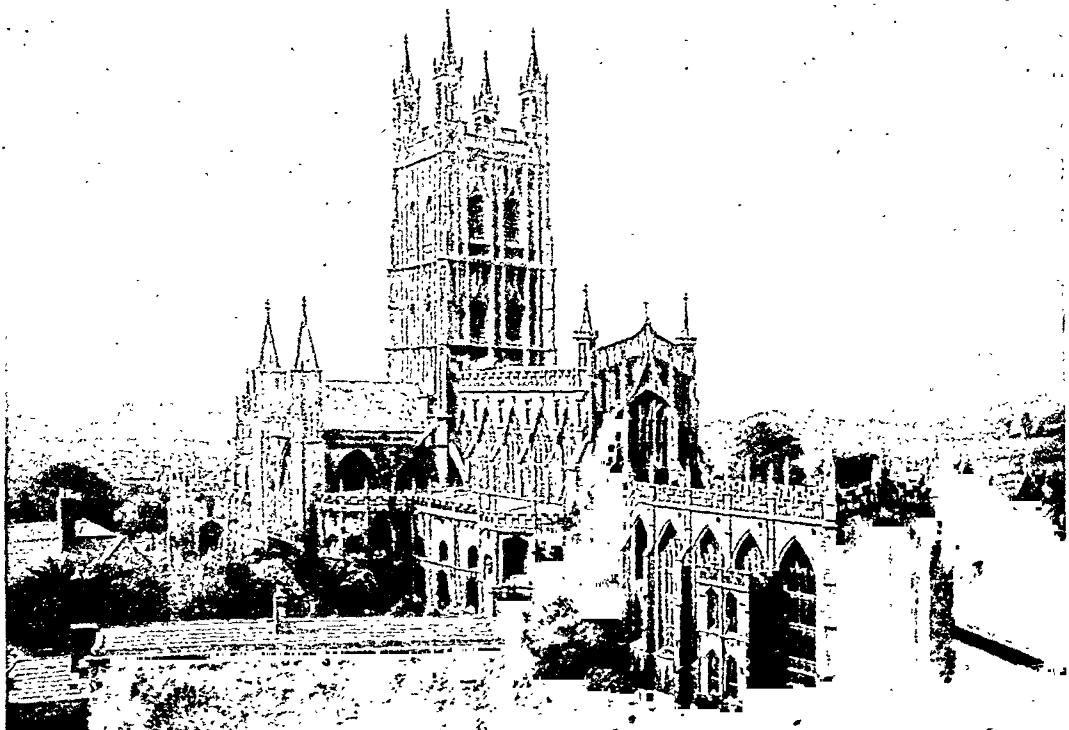
Everywhere in Eng and one comes upon rem nde s of the past He e the *u ns of Ludlow Cast e built* by the No mans n the 11th cen u y to gua d the We sh bo d towe abo e the mode n town of Ludlow in Shropshire The round tower s a chapel the square build ng s a keep

The forests that once covered most of England were cut down long ago But generation after generation has worked on the landscape planting orchards and groves of oaks and separating fields and pastures with hedges of hazel or hawthorn Visitors prefer to walk or cycle on the winding country lanes. Footpaths known as





The carved stone arches of Exeter Cathedral (left) form a vaulted roof more than 300 feet long. The church was begun in the 12th century and completed in the 14th in the purest Decorated style of Gothic architecture. In Lincoln Cathedral (right), built in the 12th and 13th centuries, the Early English style of Gothic culminated. It has the highest central tower in England (271 feet).



Gloucester Cathedral was a simple Norman church in 1088. Through four centuries, additions and enrichments were made. The exterior is a fine example of the 15th-century Perpendicular style of Gothic architecture. The stately tower is 225 feet high.

"rights of way" cross the fields and private estates The walker usually does not have to open heavy pasture gates, he can climb over them on a pair of stair steps, called a stile

Even the countryside is thickly settled In every stretch of landscape one sees isolated farmhouses or quiet villages nestling by streams Here and there stand a ruined castle or an abbey, a stone cottage two or three hundred years old with a roof of heavy thatch, or an equally old country house of the aristocracy, set in acres of parks and lawns These great houses are rapidly becoming national monuments like the ruined castles and abbeys Their former owners—the landed aristocracy—have become impoverished through exceedingly high income taxes and death duties (inheritance taxes)

Going to School in England

England provides free education for all children in tax-supported schools But parents who can afford to do so prefer to send their boys to private boarding schools *From the age of nine until they finish college* they are never home except for holidays Many girls also go to boarding schools, usually at a later age The most select and expensive of the boys boarding schools are called *public schools* (This is exactly contrary to the usage in the United States where a public school is tax-supported and attendance is free) The oldest and most fashionable public schools are Eton Harrow, and Winchester These schools and the less fashionable Rugby, formed many traditions of education that were passed on to the free schools

Local communities provide nursery schools for children two to five From five to eleven the children attend junior schools *The majority then enter a "modern"* school or a technical school Those who want to prepare for a university or a profession take an examination before leaving the junior school If they are successful they receive a scholarship for a 'grammar school (so called because in earlier times the main course was Latin grammar) When they finish the grammar school, at the age of 18, they may try for a university scholarship This pays maintenance as well as tuition for needy students County colleges provide compulsory part-time education for young people under 18 not attending school full time

Children in all schools wear some sort of uniform The *girls usually wear a navy blue pinafore dress over* a white blouse, and a round felt hat or beret bearing the school badge The boys wear wool suits usually gray, white flannel shirts, a tie of the school colors, and the school badge on a bright-colored cap In some of the public schools dark suits and starched collars must be worn

Students in English schools are expected to study much harder than in American schools Senior students, called "prefects," maintain school discipline *Children learn to play fairly and to lose, if they must* lose, with good humor During the summer vacation, Scouts and Guides organize hiking and camping trips The Youth *Hostels Association* provides inexpensive shelter for young holiday makers on vacation

A TYPICAL BIT OF 'OLD ENGLAND"

Thatched cottages blend into the English landscape as though they had grown there Some are hundreds of years o d Particularly in Devon and Dorset farmers may still be seen leveling and pegging down a new roof of yellow wheat straw

*All the large cities have institutions of higher learn*ing The most famous Engl sh universities are ancient Oxford and Cambridge (*see* Oxford) The largest is the *University of London*

English Farmers Get the Most from the Soil

The soil of England is of only moderate quality, and the cool moist climate limits the variety of crops that can be grown Only in the east and southeast is there sunshine enough to grow wheat The wet western regions are excellent for grasses For centuries the English have pastured sheep and cattle on these lush meadows Even in the east and south large areas are given over to dairy farms English stock raisers pioneered *in improving domestic animals, and England* still exports more highbred livestock than any other country (*see* Cattle, Sheep)

Through crop rotation and the liberal use of fertilizers English farmers get the most from the soil Cabbage and root crops (potatoes sugar beets and turnips) grow well in the cool climate The chief grain crops are wheat, for bread, oats, for livestock, and barley, for beer Hardy fruits thrive in the Midlands and in the south

Before the second World War England was producing only a third of the food needed for its large population The farmers concentrated on producing high-*quality foods—prime* beef, lamb and mutton, ham, bacon and cheeses During the war they plowed up grasslands to produce more wheat and potatoes, and increased dairying at the expense of beef and mutton Before the war ended England was producing more

than half its food. When peace came, the government took all possible steps to maintain the high output.

Most of the land was formerly held in great estates and worked by tenant farmers. These estates have been gradually breaking up, and ownership is passing to the people who work the farms. Three out of four farms are less than a hundred acres.

Fish is the only food the English produce in sufficient supply for the home market. The most important fisheries are in the North Sea on the famous Dogger Bank (*see* North Sea). From the great fishing ports of Grimsby, Lowestoft, and Great Yarmouth on the east coast the fish are sent by fast trains to London's Billingsgate, the world's largest fish market. Oysters and herring are obtained around the entire coast, and trout and salmon are caught in streams.

English Industry Is Based on Coal

Coal has been mined in England for centuries. Some small mines have been worked out. In others the need for working at greater depths has increased the cost of mining. But it is estimated that England has enough coal to last, at its present rate of consumption, for at least two hundred years more. The great coal fields around Newcastle, in the northeast, extend far out under the sea. The second great deposit underlies the Black Country in the Midlands.

England owed its rise as an industrial nation largely to its coal deposits. Coal ran the factories, ships, and railroads. The short land journey to the sea made it possible to sell cheaply abroad. After the first World War coal became a "sick industry," with chronic unemployment. Many ships had been converted to oil burners; and countries that had bought British coal developed their own mines or hydroelectric power. After the second World War England again had a large market waiting for coal; but production dropped because of a scarcity of equipment and skilled miners.

In 1946 the Labor (Socialist) government took over ownership of all coal mines in the United Kingdom. In 1948 the entire electrical industry and the gas and coke industry, both of which depend on coal, were also nationalized.

GOING DOWN INTO THE COAL MINES

Dropping down to the black underworld in a "cage," the miners carry lamps to light their way. Coal has been mined in England for many centuries In some mines it has become necessary to work at very great depths.

Besides coal, the only mineral produced in any quantity is iron. England's iron ores, however, are of low grade. High-grade ores must be imported Small amounts of lead and zinc are mined, and some tin is still obtained from the famous mines in Cornwall, which have been worked since ancient times (*see* Tin) England's quarries supply great quantities of granite and limestone for building, and china clay (kaolin) for pottery. England must import its petroleum.

England's Manufacturing Industries

England's large manufacturing cities, with the single exception of London, are located on or near the coal fields. The tremendous iron and steel industry centers at Birmingham, in the heart of the Black Country, and follows the coal fields east and north through Coventry, Nottingham, and Sheffield to Leeds and Hull (*see* Birmingham; Sheffield, Leeds).

These cities produce locomotives, railway cars, rails, bridges, marine engines, heavy machinery of all types and machine tools, aircraft, automobiles, trucks, bicycles, electrical equipment, scientific instruments, cutlery, silverware, and a host of minor products. Shipyards on the Mersey River, at Liverpool, on the Tyne at Newcastle, and on the Thames produce all types of ships, small and large.

Textiles rank next to the metal trades in value of products. In the 18th century it was found that the moist climate of Lancashire, on the west coast, was ideal for cotton spinning. Various towns developed particular processes. Oldham spins medium-size threads, Bolton and Preston large sizes. Other towns are famous for dress goods, draperies, hosiery and knitwear, and dye works. From Manchester, in the heart of this great factory district, the cotton cloth is sent to Liverpool, to be distributed throughout the world (*see* Manchester). After the first World War, the competition of cheap foreign cloth depressed England's cotton industry. Today an increasing number of the Lancashire looms are weaving rayon and nylon fabrics.

England is still the world's leading exporter of woolen cloth. This industry centers in west Yorkshire, and around Leeds and Bradford (*see* Leeds).

THE FAMOUS ENGLISH POTTERIES

S oke-on T en shown he e s he en e of a group of five owns a ed he P e s n S affo dsh e He e a e produ ed he famous Wedgwood and Spode h na G ea kilns like huge bo es owe abo e the wo k s houses

F ne clays of Corn all are n ade nto ch na at the famous Potter es of Stoke-on T ent n the M d lands south of Manchester Products ude the famo s Wedgwood ch na the fine b ne cl na ca e l Spode nd ndust al ceram cs—t les d a l j e and san tary eartl en are

England s m n ng and manufacturing industries became closely interwoven with those of Wales and Scotland following the Industrial Revolut on Northern Ireland also makes important contribut ons to the products of the United Kingdom (For the ndustr al pos t on of the nat on as a whole *see* Great Brita n)

Transportation and Communication

No country n the world has such a dense web of ra l ays and highways as Eng and London the hub of the vast system has ts o n great transport web of undergrounds subways) and busses R ver transport s un mportant except on the Thames wh h carries ocean vessels up to London Canals l nk many of the ndustrial c t es but most of them are too shallow and narrow for present traffic de mands An ex ept on is the famous Man chester Sh p Canal which connects Man chester w th the Mersey River and L erpool Regular air serv ices operate w t un the country but are not much used s n e distances are so short B t sh overseas a r ways operate all over the world

England has excel lent ports on all ts bordering bod es of water Most of them are located on w de estuaries that p erce the coastal plain The largest port is

SKILLED CRAFTSMEN AT WORK

A he a s sm h n Sheffie d u s out an in ate des gn w h a saw A the ght, a pottery wo ke de o a es a Wedgwood p a e by p essing on a bo de of mo ded cameo like eliefs n whi e pas e This p o ess s called *pa e-su pâ e* The china then goes to a kiln o be fired at a high empe a u e

London, at the head of the Thames estuary. It receives the greater part of England's imports. Liverpool, on the Mersey River, is the great port for the Lancashire district. Hull, on the Humber, handles the commerce of Yorkshire. Newcastle-upon-Tyne is a great coal-exporting port. Southampton and Plymouth, on the south coast, are ports of call for transatlantic liners. Bristol, the port nearest to America, handles much of the trade between the United States and southern England. (*See* London; Liverpool; Newcastle; Southampton; Plymouth, England; Bristol.)

The national government owns and runs all railways, including the London system, and all air services. Telephone, telegraph, cable, and radio broadcasting are also state monopolies. Radio listeners pay fees for the use of "wireless" sets. The British Broadcasting Corporation controls all broadcasting.

The Church of England

England has an established state church headed by the ruling monarch. It is called the Anglican, or Protestant Episcopal, church. Large numbers of the English people, however, belong to "nonconformist" Protestant faiths, principally the Methodist, Congregationalist, and Baptist. The Society of Friends (Quakers) and the Unitarians, though few in number, have had great influence in business and politics. There are also many Roman Catholics in England.

In the Church of England the ecclesiastical system is episcopal (that is, governed by bishops). The country is divided into two sections, Canterbury and York, each under its own archbishop. The archbishoprics are divided into bishoprics, headed by bishops. These in turn are subdivided into parishes. A cathedral church is governed by a chapter consisting of a dean, canons, and prebendaries. Vicars, rectors, and curates officiate in the parish churches.

The Anglican church provides High Church and Low Church observances. The High Church has almost as much ritual as the church of Rome. The Low Church has much less ritual.

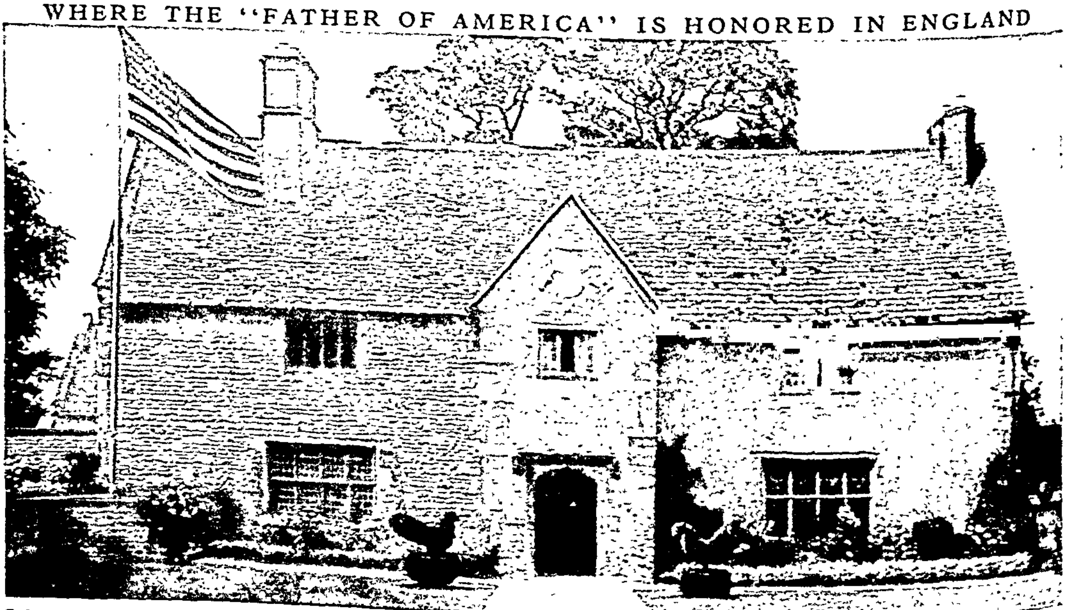
National and Local Government

England has had no separate national government since 1707, when the Act of Union joined Scotland to England and Wales. (*See* English History; Great Britain; Parliament.)

The English counties (also called *shires*) are of ancient origin. Many of them were originally small kingdoms. Since the 10th century there have been only slight changes in names and boundaries. After the Norman Conquest (1066) the shire was frequently called a county. In England the county is the largest subdivision in the country. In this respect it corresponds to an American state. Its government, however, is completely different.

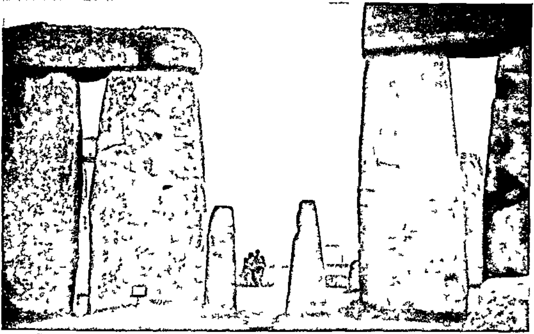
The counties are governed by county councils. The council members are popularly elected and elect their chairmen. They receive no salaries. The large cities are independent of the county governments. London is a county in itself, and other large cities, such as Manchester and Birmingham, though within the boundaries of a county, are independent political units called *county boroughs*. County councils and county borough councils levy local real-estate taxes, called *rates*, to pay for local services, such as sanitation and fire protection. They also receive grants from the national government to administer national services, such as public health and education. (For Reference-Outline and Bibliography, *see* Great Britain.)

WHERE THE "FATHER OF AMERICA" IS HONORED IN ENGLAND



Sulgrave Manor, in Northamptonshire, was the home of George Washington's ancestors. Lawrence Washington bought it from Henry VIII in 1539, and the Washington family lived here until 1610. George Washington's great-grandfather, who came to Virginia in 1657, was born here. The house was bought in 1914 by a British society and is maintained by an American endowment.

The MAKING *of* MODERN BRITAIN



These stones are part of the huge circular temple at Stonehenge which seems to have been erected for the wor ship of the sun They show the engineering sk ll of the primitive people who set them up about 4 000 years ago

ENGLISH HISTORY Long ages ago the Brit sh Isles formed a peninsula of Europe The Engl sh Channel was a broad pla n People and anima s from southern Europe traveled across th s plain and made the r home in the dense forests that then covered Brita n The people belonged to the earliest stage of civilization the Old Stone Age They moved stealthily over the damp green woodland stone ax in hand hunting mammoth horse and reindeer They l ved in caves had no domest c animals and took no care of the r dead

After an immense stretch of time the land subs ded and Ireland was separated from Britain Later the sea flo ved into the narrow Strait of Dover and made Britain also an island The people advanced slo vly to the New Stone Age In th s period they mined fl nts for the r weapons and polished them to give a sharp cutting edge They laid a vay the r dead in long or round chambers called *barrows* and heaped over them mounds of earth and stone From remains found in these barrows we know that they tamed horses sheep goats cattle dogs and hogs and that they grew wheat and barley and later flax to make linen

Around 2500 B C —perhaps even earlier—sea mer chants from Med terranean countries discovered the islands in the northern seas The Phoenicians who traded with many lands came again and aga n to buy t n which lay close to the surface in Cornwall (*see* Phoenicians) The native people learned from the t aders how to smelt t n with copper to make bronze tools and weapons With this knowledge the long Stone Age ended and the Age of Bronze began In the later Bronze Age the people of Britain erected ave-nues and circles of huge gran te slabs l ke that at Stonehenge These were probably their temples (*See also* Stone Age Man)

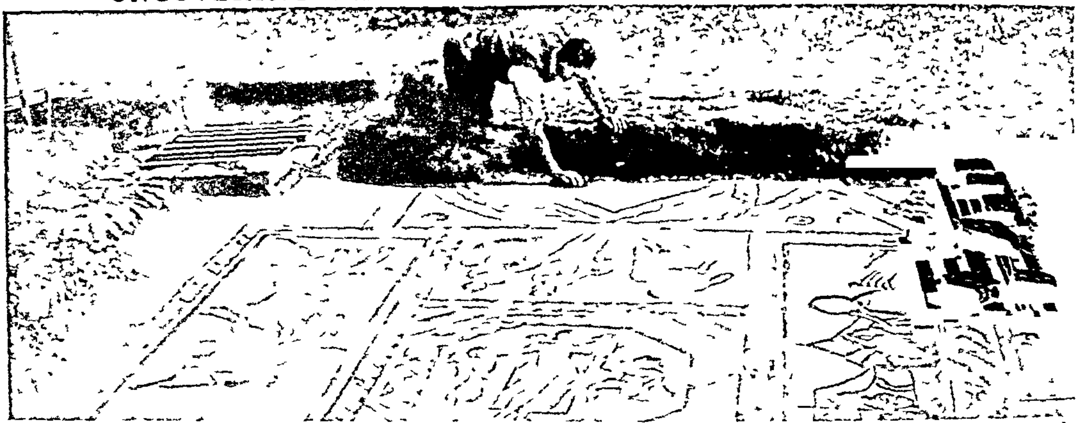
Some five or s x centuries before the birth of Christ a tall fair people called Celts came across the channel in small boats The Goidels or Gaels (who are st ll found in Ireland and in the Highlands of Scotland) formed the first great m grat on Then came the Brythons or Britons (still found in Wales and Cornwall) who gave the r name to the island of Britain The Celts knew ho v to smelt iron and were sk lled in arts and crafts They became the ruling class and the nat ve folk adopted the Celt c language and *the Celts Dru d relig on (see Celts)*

Rome Rules Britain Nearly 400 Years

Jul us Caesar ra ded Br ta n in 55 B C and again in 54 B C (*see* Caesar) Nearly 90 years later Rome undertook the conquest of the island in earnest In A D 43 Emperor Claudius gathered a force of about 40 000 to invade the island Within a few years the Romans subdued all the area that is no v England and added it to the Roman Emp re as the prov nce Britannia

A wido ved Celtic queen golden haired Boad cea led a great upris ng against the Romans in A D 61 but her barbarian horde was no match for the Roman sold ers The people of Scotland were harder to sub-

UNCOVERING THE MOSAIC FLOOR OF A ROMAN VILLA



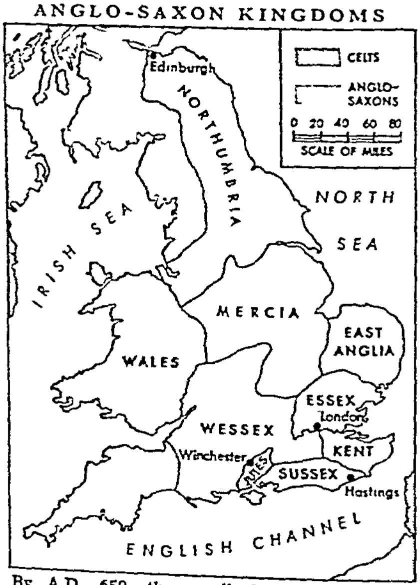
During the 400 years that the Romans ruled Britannia they built many large and luxurious houses in the country as well as in the towns. The country estates were called villas. Here we see an English workman carefully uncovering the mosaic floor of a villa in Somerset. Remains of more than 50 villas have been discovered in this southwest country.

due. Emperor Hadrian decided conquering them was not worth the trouble; so he had a wall built 100 miles long across the narrow neck of the island to keep them out (*see* Scotland). South of this wall the Romans built more than 50 cities and connected them with military roads. Some of these roads, such as the famous Watling Street, still serve as the foundations for modern highways.

The cities contained Roman baths and open-air theaters, temples to Jupiter, Mars, and Minerva, and houses with colonnaded terraces, mosaic floors, and hot-air furnaces. Upper-class Britons in the towns spoke Latin and wore the Roman toga. Commerce and industry prospered, protected by Roman law. Later, when Rome became Christian, Roman missionaries spread Christian teachings in Britain.

In A.D. 410 the Goths swept down on Rome and no more Roman legions came to protect Britannia. One by one the legions already there were withdrawn. The Britons, left to themselves, were unable to form a government. Local chieftains warred with one another. Barbarians from Scotland and pirates from Ireland ravaged the land. In vain a Briton wrote for aid to a Roman consul, saying: "The barbarians drive us to the sea; the sea throws us back on the barbarians."

ANGLO-SAXON KINGDOMS



By A.D. 650, the small Anglo-Saxon tribes had merged into small kingdoms: Northumbria, Mercia, East Anglia, Wessex, Essex, Kent, and Sussex. The original Celtic population survived in the western highlands.

Anglo-Saxon Invasions

Soon a more dangerous enemy appeared. Across the North Sea came bands of pirates in long black ships. They were of Teuton (German) stock—Angles, Saxons, and Jutes—from the region of modern Denmark. They found the island easy to invade. In the south and west a low coast thrusts out toward the continent From the coast navigable rivers lead inland across a rolling plain. The land itself, covered with green the year round, seemed miraculous. Not until centuries later did people learn that the British Isles, so far to the north, owe their mild climate to the warm Gulf Stream.

The invaders plundered city after city and drove the Britons ever farther west. Farmers and herdsmen followed in the wake of the warriors. The newcomers were pagans, worshipers of Odin and Thor (*see* Odin; Thor). They had no use for Roman cities or Roman law. They cleared the forests to make farmland and built long houses grouped around the large log hall of their chief, which was decorated with carving and paint and hung with shining armor.

By the year 600 the ruin of Rome's Britannia was complete. The original Celtic stock survived only in the mountains of Wales and in Cornwall. Except in these areas, Christianity and the Celtic language died out. Britain came to be called Angle-land (later England) after the Angles, and the people spoke Anglo-Saxon (*see* English Language).

The small Anglo-Saxon tribes gradually merged into seven or eight little kingdoms. The Jutes, a small tribe, held the Isle of Wight and land to the north The Saxons established themselves in Wessex, on the south coast. The Angles ruled Mercia, in the Midlands; East Anglia, on the east coast; and Northumbria

in the northeast When a king died an assembly called the *Witan* (wise men) chose a ne v king from the roy al family

The Mission of Augustine

In the year 597 Augustine an Italian monk landed with 40 followers on the coast of Kent He had been sent by Pope Gregory I to win the Angles to the Christian faith He bapt zed Ethelbert king of Kent repaired the old Roman church at Canterbury and founded a Bened ctine abbey there The pope consecrated h m archbishop for his services From that t me on the archbishop of Canterbury has been primate of the church in England (*See* Canterbury)

Christian ty spread rapidly Learned monks brought to England a knowledge of architecture law philosophy and the Latin language A new c v liza t on began to take shape Soon however it was checked by another invas on of barbarians

Danes Invade England

The new invaders were Scandinav ans from Norway and Denmark (*see* Northmen) The Engl sh called them Danes Summer after summer these bold p rates rowed up the rivers in their long boats plundered the rich monasteries and went home w th gold and gems Soon after 850 a great force rema ned in England bent on conquest Then permanent settlers poured in The Danes were farmers and traders as well as warr ors When they founded a to vn—usually a port—they fortified t and opened a market All eastern England north of the Thames passed under the rule of the Dan sh *jarls* (earls) and came to be known as the *Danelaw* (under Danish law)

The Danes would probably have w ped out Christianity in England if it had not been for Alfred the Great king of Wessex Alfred defeated the Danes great army at Chippenham in 878 and forced the Danish leader to s gn a treaty agreeing to leave Wessex free The Danes prom sed also to be baptized and many d d become Christians In the last years of h s re gn Alfred began English prose literature by translating Latin books into Anglo-Saxon He also built schools and ordered the Anglo-Saxon Chron cle the first historical record of England to be begun (*See also* Alfred the Great)

A century after Alfred s time the Danes started once more to raid England s shores In 991 the incompetent Ethelred the Unready tried to buy them off by paying them yearly a large sum in silver called the *Danegeld* or Dane tax which was raised by a heavy tax on the people Nevertheless the Danes came again and in 1016 Canute the k ng of Norway and Denmark made himself king of England also He proved to be a wise and strong ruler but after his death h s empire fell apart and in 1042 the Danish dynasty in England ended (*See* Canute Harold I)

The English line then returned to the throne w th Ed vard the Confessor a son of Ethelred the Unready Ed vard had been reared by French monks He was called The Confessor because of h s personal piety

The Norman Conquest (1066)

Meanwhile other Northmen had been raiding the coast of France On the south shore of the English Channel they establ shed the duchy of Normandy These Northmen or Normans became French in language and culture In the 11th century Normandy was rich populous and powerful (*See* Normandy)

When Ed vard the Confessor died ch ldless W lliam duke of Normandy cla med the Engl sh crown He was a second cousin of Edward and he had exacted an oath from Harold earl of Wessex to support his cla m The Engl h Witan nevertheless elected Harold king William appealed to the pope The pope supported William and declared Harold guilty of perjury

William gathered together a host of horsemen slingers and archers and set sa l for England Harold met l im with foot soldiers armed w th battle axes The t vo armies clashed in the famous battle of Hastings on Oct 14 1066 Harold was killed on the battlefield The victorious William went up to London and was crowned king of England in Westminster Abbey on Christmas Day (*See also* Harold II William I the Conqueror Hastings Battle of)

For five years Will am vas busy putting down revolts in his new kingdom He seized the land of all

KING ALFRED LETS THE CAKES BURN

An old story tells how Alfred once sought refuge in a herdsman s hut The housewife not knowing who he was asked him to watch her baking while she went out Alfred brooding over his problems let the cakes burn When the housewife returned she scolded him.

ENTRANCE TO A WALLED TOWN

Every town had to be a fortress in the Middle Ages Within the high thick walls the houses were crowded close together. This town is typical of the 11th century.

Saxons who fought against him and distributed it among his Norman followers—except for vast tracts that he kept for himself as "crown lands" From his crown lands the king derived his chief support. On his own estates and on those of favored barons he ordered strong fortified castles built.

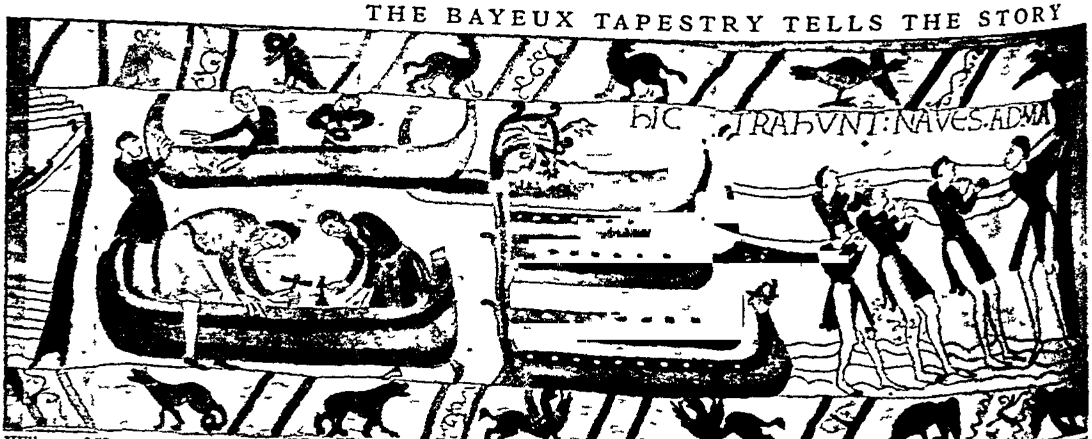
In return for the grant of land—called a *fief*—each lord had to swear loyalty to the king, furnish knights for the king's army, attend the king's court, and aid the king with money on certain occasions. If the lord failed to perform any of these duties, the king might declare his fief forfeited. Otherwise the fief was held by the lord and his heirs forever. Farmers were reduced to the class of serfs, or *villeins*, as the Normans called them. The estate on which they worked was called a *manor*. A villein could not leave the manor on which he was born. This system of land tenure was the basis of *feudalism*, which held sway all over Europe in the Middle Ages. (*See also* Middle Ages; Feudalism; Knighthood)

The efficiency of William's rule is shown by the survey he had made of all the property in England. His agents visited every manor, found out who owned it how many people lived there, and reported what the feudal lord ought to pay the king in taxes and feudal service. The findings were recorded in the famous Domesday Book, one of the most valuable documents in English history The record was called Domesday (day of doom) because no one could escape its judgment

The date of the Norman Conquest—1066—is one of the most important dates in English history The Conquest cut England's ties with Scandinavia and connected England with France French, the language of the Norman rulers, became blended with the Anglo-Saxon speech of the common people, enriching the native language with many new words and ideas. Wooden churches and abbeys were replaced with beautiful stone buildings in the Norman style. Foreign monks and bishops, brought in by the Normans, made the monasteries centers of learning. Anyone who wanted to study went into the church as a matter of course. The king's secretaries, judges, and most of his civil servants were churchmen, because only churchmen had the necessary education.

William I, the Conqueror, promised when he was crowned to govern according to the laws of Edward the Confessor. The Witan survived in his great coun-

THE BAYEUX TAPESTRY TELLS THE STORY



William of Normandy conquered England in 1066. About 20 years later, his half brother Odo, bishop of Bayeux, had the event commemorated in the Bayeux tapestry, which is still preserved in Bayeux, France. The tapestry is a seamless strip of linen, 230 feet

council of advisers the *curia regis* which was attended by earls barons bishops and abbots but the council no longer had the power to choose the king As feudal overlord of the whole country William bequeathed England on his death to his second son William II He left Normandy to his eldest son Robert

William II Henry I and Stephen

William II (called William Rufus the Red King) came to the throne in 1087 He was a harsh ruler and few mourned him when he was killed by an arrow—shot by an unknown hand—while he was hunting (*See* William II) Robert meanwhile had gone off on the First Crusade to recover the Holy Land from the Turks A third son Henry I was therefore able to become king without a struggle (1100) When Robert returned from the Holy Land Henry crossed the Channel defeated him and gained Normandy also He gave both England and western France a peaceful orderly rule (*See* Henry I)

Henry I exacted a promise from the barons to recognize his daughter Matilda as their ruler However when he died some of the barons broke their promise and chose instead Stephen a grandson of William the Conqueror Stephen was a gallant knight but a weak king Throughout his reign lawless barons fought private wars each seeking to increase his own power When Stephen died (1154) the people were ready to welcome any strong ruler who would restore order (*See* Stephen)

Henry II Restores the Royal Power

The strong ruler was found in Henry Plantagenet count of Anjou His mother was Matilda (or Maud) daughter of Henry I of England His father was Geoffrey of Anjou He came to the throne of England as Henry II first of the Plantagenet line of kings who were to rule England for 245 years (The name Plantagenet which means broom plant was given to his father because he wore a sprig of this plant in his cap) By marriage and inheritance Henry II came into possession of all western France as well as England He spent most of his long reign 1154–89 in his French possessions yet he found time to be one of England s great rulers

Henry II sent out trained justices (judges) *on circuit* to different towns in England to sit in the county courts The judges kept records of their cases When one judge had decided a case other judges trying the same kind of case were likely to adopt the decision that had been recorded In the course of years legal principles came to be based on these decisions Thus a new law grew up that took the place of the personal opinions of judges and kings Because this case law applied to all Englishmen equally it came to be called the *common law* The circuit justices also made more extensive use of juries and started the grand jury system in criminal law (*See also* Law Jury)

Henry carried on a long and bitter struggle with Thomas Becket archbishop of Canterbury who asserted the independence of the church courts against the king s authority The church triumphed when Becket was murdered After making peace with the pope Henry did penance at Becket s tomb Becket became a sainted martyr and for centuries people made pilgrimages to his shrine at Canterbury (*See also* Henry II Becket)

Richard the Lion Hearted the brave and reckless son of Henry II succeeded his father in 1189 After a few months he left England while he went off on his long crusade The country suffered little in his absence because Hubert Walter governed it better than Richard would have done (*See also* Richard I Crusades)

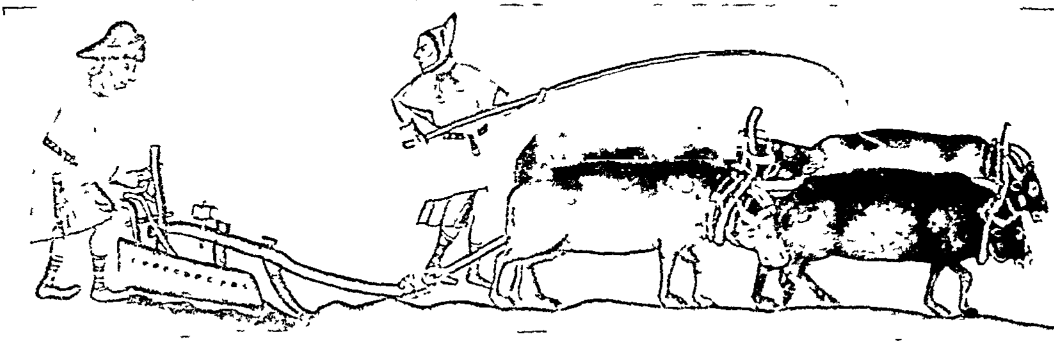
King John and Magna Carta

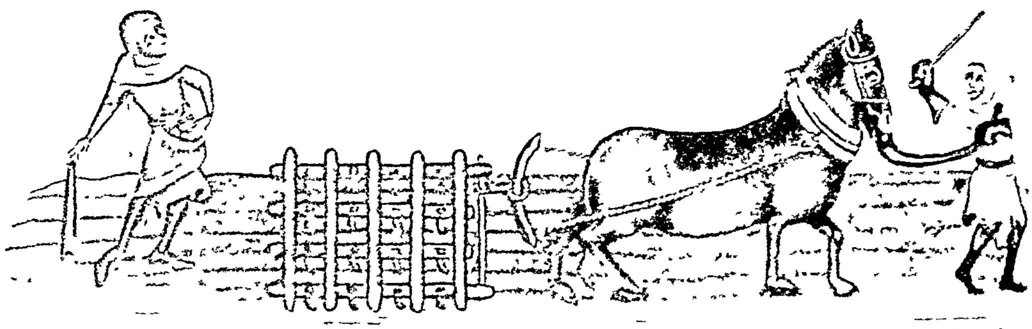
In 1199 Richard I was succeeded by his brother John the most despicable of English kings By a series of blunders John lost almost all the vast Plantagenet possessions in western France except the southwest corner The English barons refused to help him regain his territory Angered by his tyrannical rule they joined together and drew up a list of things that even a king might not do On June 15 1215

OF THE CONQUEST OF ENGLAND BY THE NORMANS

long and 20 inches wide covered with 72 scenes in colored worsted embroidery This section of the tapestry shows Norman workmen building and loading Viking dragon ships in preparation for the invasion Along the top and the bottom run decorative borders

PLOWING, HARROWING, AND PLANTING IN THE MIDDLE AGES





Oxen were thin, lightweight animals in the Middle Ages and plows were of clumsy construction. At least four oxen were needed to draw a plow and sometimes as many as 20 were hitched to it. Since few men owned more than a single ox, the villagers worked together at plowing time. Work horses were rare; but here is one pulling a harrow. The artist has drawn the harrow as if it were standing on its side. The pictures are from the Luttrell Psalter, an illuminated manuscript of the 14th century.

they forced him to set his seal to this Great Charter (in Latin, Magna Carta) of English liberties.

Magna Carta is regarded as one of the most notable documents of history. The rights it listed were, in the main, feudal rights of justice and property that had been recognized by previous kings; but now for the first time these rights were insisted upon against the king's will. Thus an important principle was established—that the king himself must govern according to law. In later years, whenever a king overextended his powers, the people could remind him of Magna Carta. (*See also* John; Magna Carta.)

The Rise of Parliament

Henry III, John's eldest son, was crowned at the age of nine and ruled 56 years, 1216–72. He was pious and well meaning but incompetent and extravagant. The barons took a strong stand against him in Parliament. (The term *parliament* was gradually coming into use for the Great Council.) In 1264 the barons, led by Simon de Montfort, rose against the king and brought on the Barons' Wars, which lasted for three years. The wars ended when Earl Simon was killed in battle. (*See also* Henry III; Montfort)

Henry III's son, Edward I, who ruled 1272–1307, wisely accepted the limitations on the king's authority. His parliament of 1295 is called the Model Parliament because it included representatives of both shires and towns as well as the Great Council. Many of the laws passed in Edward's reign exist in modified form today.

Edward I conquered Wales and united it to England but failed in his effort to subdue Scotland. He died on his way north to put down an uprising led by the great Scottish hero Robert Bruce. His incompetent son, Edward II, then took up the task and was decisively defeated by Bruce at Bannockburn. In 1327 Parliament used its new power to depose Edward II and place his son, Edward III, on the throne. (*See also* Edward I; Edward II; Edward III.)

The Flowering of English Medieval Life

The 13th century was a time of great enthusiasm for art and learning. In architecture, the low square towers and round arches of the Norman period gave place to the delicate spires and pointed arches of the Early English, or Gothic, style. New learning was brought into England by friars and other scholars from the continent. Oxford University won renown all over Europe. One of its teachers, Roger Bacon, a friar, urged the study of nature and the experimental

method in seeking knowledge but the world was not yet ready for science The Crusades opened up commerce with the Orient and brought in new ideas as well as new foods and silk fabrics (*See also* Architecture Bacon Roger Crusades)

Towns became noted for particular manufactures—woolen or linen cloth cord knives needles iron leather soap Craft guilds held a monopoly of manufacture and merchant guilds controlled local markets Foreign merchants were allowed to sell their wares only at certain annual fairs The Merchants of the Staple first of the great English trading companies obtained a monopoly of the export of the famous English wool that England had been supplying for centuries to expert weavers in Flemish and Italian cities (English weavers still made only coarser cloths) The serfs were still bound to the soil but if their lord treated them badly they could run away and find work in a town There they were safe from recapture after a year and a day (*See also* Guilds Fairs)

The Hundred Years War

Knighthood was still in flower while Edward III was on the English throne 1327 77 The king himself a perfect figure of chivalry excelled in beautiful feats of arms He soon had a chance to prove his skill on the battlefield as well as in tournaments for during his reign began the long struggle with France known as the Hundred Years War In 1346 Edward s army won a brilliant victory at Crécy with a new English weapon the longbow The next year Edward took Calais a French seaport (*see* Calais) In 1356 his son the Black Prince won the famous battle of Poitiers (*See also* Edward III Knighthood Archery Hundred Years War)

The war was brought to a temporary halt while the Black Death swept over western Europe (1348–49) When the great plague had spent its fury more than a fourth of England s population had perished Whole villages were wiped out and great areas of farmland went to weeds The serfs who survived demanded high money wages If their lord refused they moved to another manor The government tried to halt the rise in wages and bind the laborers to their manors once more but it could not enforce its Statute of Laborers The landlords sought labor at any price and the laborers formed combinations (what we would now call unions) to resist the law John Wycliffe s poor priests (Lollards) and other traveling preachers increased the discontent by denouncing the land lords (*See also* Black Death Wycliffe)

Richard II grandson of Edward III was 14 years old when a great band of peasants headed by Wat Tyler marched on London (1381) from Kent The boy king went boldly out to meet them I am your king he said I will be your leader We will that you make us free forever the peasants asked Richard promised to help them and they returned peaceably to their homes However the king did not keep his promise and within a week the judges hanged 1,500 ringleaders of the revolt (*see* Tyler Wat) The feudal system of villenage however could not be revived The serfs were gradually giving place to a new class of farmers free yeomen

Richard II thirsted for absolute rule and came into conflict with the powerful barons His cousin Henry duke of Lancaster led a revolt against him in 1399 imprisoned him in the Tower of London and forced him to abdicate Parliament then placed Henry on the throne as Henry IV and the Plantagenet line came to an end (*See also* Richard II)

The House of Lancaster ruled England only 62 years, 1399–1461 During this period three Henrys —father son and grandson—wore the crown Their reigns were filled with plots and rebellions murders and executions Their hereditary title was defective Parliament had made them kings and they depended on its support to keep the throne They therefore consulted it on all affairs (*See also* Lancaster Henry IV Henry V Henry VI)

The End of the Middle Ages in England

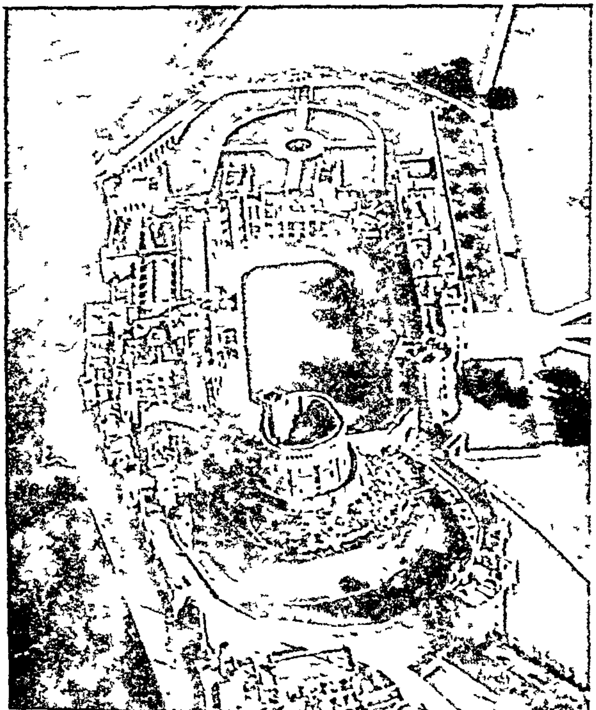
In 1455 two years after the Hundred Years War ended *the House of York and the House of Lancaster* plunged into a long and bloody struggle for the crown called the Wars of the Roses Henry VI of the House of Lancaster was captured and murdered Edward IV of the House of York spent most of his reign fighting to keep his crown The last Yorkist king Richard III gained the throne by having Edward s two little sons murdered Peace came at last with the death of Richard III in the battle of Bosworth Field The date of Richard s death—1485—may well be used to mark the close of the Middle Ages in English history (*See also* Roses Wars of the Edward IV Edward V Richard III)

The Wars of the Roses were the death throes of the feudal system Battles and executions thinned the ranks of the nobles and their fortified castles were no longer impregnable after the invention of gunpowder A new aristocracy was pushing up through the broken crust of feudal society In the towns a rich capital st class appeared Country squires—the landed gentry —also grew wealthy The new aristocracy began to seek political power

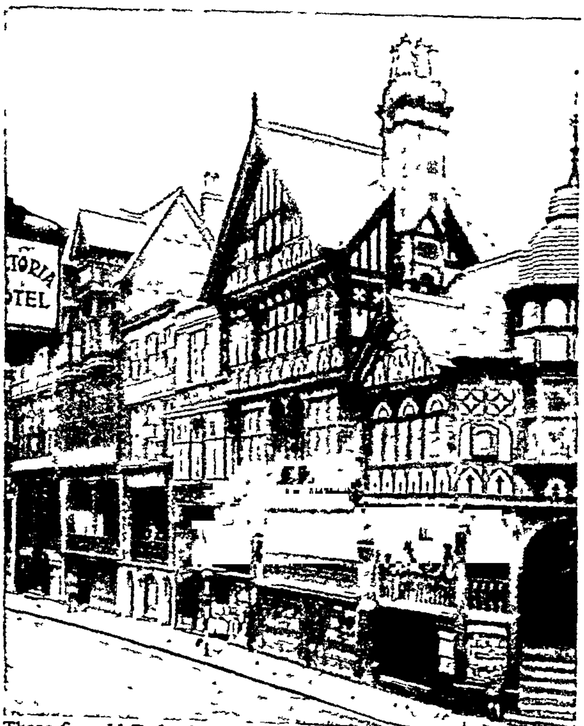
England no longer sent its finest wool to Flanders and Florence to be made up into cloth It was now the chief cloth exporting country in the world Enterprising employers grew tired of the restrictions of the guild system and found another means of manufacture They supplied wool to farmers and villagers to be spun and made up into cloth This system of manufacture called the domestic system grew steadily in the following centuries and caused the breaking up of the guild system Serfdom also gradually died out The gentry leased their land to yeomen who paid money wages to their free laborers

French the speech of the governing classes had become blended with Anglo-Saxon into an English speech somewhat similar to the language we use today The poet Geoffrey Chaucer wrote in this English and the Bible was translated into it (*see* Chaucer Tyndale) These works were among the first printed by William Caxton who brought a printing press to England from

WINDSOR CASTLE AND CHESTER'S "ROWS"



Windsor Castle is still a favorite residence of British sovereigns. It was begun by William the Conqueror and added to by later kings.



These fine old Tudor houses are in Chester. Open galleries form a continuous passage, called a "row," above the ground-floor shops.

Germany in 1476. Printing made it possible for many more people to have books and helped to spread the New Learning of the Renaissance The New Learning was actually wisdom of the ancient Greeks and Romans that had been lost to the Western World for many centuries. Renaissance which means "a new birth," was the name given to the revival of this learning. (*See also* Renaissance.)

Before the 15th century ended, Spanish and Portuguese explorers had opened up new continents across the Atlantic Ocean. This ocean was soon to become a busy highway; and the small island off the edge of Europe was to find itself in the center of the new larger world.

Henry VII, First of the Tudors

After a century of wars, England now enjoyed a century of almost unbroken peace under the Tudors (*see* Tudor). When this strong dynasty ended, England was a modern nation and had taken the first steps on the road to empire.

Henry VII, first of the Tudor line, became king by defeating and slaying Richard III in the battle of Bosworth Field (1485). He crushed the barons and once more made Parliament obedient to the king's will. Only the medieval church, still wealthy and powerful, remained an obstacle to his authority. He was popular with the "commons"—the middle classes in town and country—because he built up an orderly government, aided commerce and industry, and kept the country at peace and out of debt. With his encouragement John Cabot in 1497 piloted an English ship across the Atlantic Ocean to Newfoundland, five years after Columbus discovered the New World. (*See also* Henry VII; Cabot.)

The English Reformation

Henry VIII, ruled 1509–47, is famous as the king who had six wives in succession. When he put aside his first wife, Catherine of Aragon, the pope excommunicated him. Henry, enraged, had Parliament cut the ties that bound the English church to the papacy (1534) and forced the English clergy to acknowledge the king rather than the pope as the "only supreme head of the Church of England."

Henry's quarrel with the pope was made easier by the great Protestant Reformation that was sweeping over Europe (*see* Reformation). Yet Henry all his life claimed to be a devout Catholic. He burned Protestants at the stake almost as readily as he hanged and beheaded the "traitors" who upheld the pope. His attack on the papacy was prompted in part by greed. By dissolving the monasteries he was able to seize their immense wealth in lands and buildings and the costly ornaments of the shrines. From the shrine of St Thomas Becket at Canterbury he had carried away wagonloads of gold, silver, and jewels. He used some of his new riches to fortify the coast and build England's first real navy. At his death the royal fleet numbered 71 vessels, some of which

e fitted out with cannon (*See* Henry VIII, More, Wolsey)
Henry VIII s only son, Edward VI, s ten years old when he came to throne (1547) and he died at the of 16 (*see* Edward VI) The d Protectors who ruled in his ad favored the Protestant cause ey forbade the Catholics to hold ss to fast to do penance, to make gnmages and to use holy water y encouraged the clergy to marry, l they required Thomas Cranmer's glish Prayer Book to be read in- ad of the Latin Mass
These laws were speedily repealed en Mary, daughter of Henry VIII l Catherine of Aragon ascended throne (*see* Mary I) She had n brought up in the Catholic faith l held stanchly to it She had eral hundred Protestants burned the stake for their faith Yet the v Protestant teachings spread Mary's statutes were in turn re- aled by her half sister Elizabeth I e Elizabeth I) In Elizabeth's reign the Church England took the form it has today It kept the tholic governmental organization of archbishops, hops, and deans, but it rejected the headship of pope It permitted the clergy to marry, and again ordered the reading of the English Prayer ok Many people accepted this "middle way" t it was bitterly opposed by the Roman Catholics Papists"), and also by the extreme Protestants Puritans) who insisted on a simpler "purer" m of service with no 'Popish rites" The English re to endure nearly a century more of strife be- e they agreed to allow more than one religion

The Golden Age of Elizabeth I

The long reign of Elizabeth I, 1558–1603, was Eng nd s Golden Age The Renaissance which began in ly *in the 14th century, at last reached the north-* n island "Merry England" in love with life, pressed itself in music and literature, in architec- re *and in adventurous seafaring* William Shake- eare, poet and dramatist, mirrored the age for us verse that lifted the English language to its full- t beauty (*See also* Elizabeth I, English Litera- re, Shakespeare)
Throughout the land could be heard the sound of mmers and saws of builders—a sure sign of pros- rity Elizabethan manor houses, usually built ound an open court, blended the English style with e new Italian English glass works supplied small ar panes for lattice windows The increasing use brick made it easier to build chimneys and fire- aces even for common houses which were still the d gabled and thatched cottages of timber
English seamanship and shipbuilding reached the ghest point they had yet attained Francis Drake

THE PRINCES IN THE TOWER

Edward V and his younger brother Richard, duke of York, were murdered in the Tower of London probably by *order of their uncle, Richard III* Painting by Sir J E Millais

sailed around the world Walter Raleigh made the first attempt to *found an English colony in America* These and other bold "privateers" reaped rich rewards—chiefly at the expense of Spain—*from piracy, smug-gling* and slave trading Elizabeth encouraged them on the ground that they protected Protestant England against Catholic Spain (*See also* America Drake Raleigh, Hawkins)
The defeat of the Spanish Armada (1588) established the superiority of English ships and sailors and made the English conscious of their ocean destiny (*see* Armada Elizabeth I) English merchants began to seek distant markets for their goods In 1600 the now old queen chartered the famous East India Company, giv- ing it a monopoly of trade with the Far East From this small beginning Britain's Indian Empire was to grow

The Enclosures

Not all classes shared in the increasing prosperity The population had doubled since the Black Death and now reached about 4 million There was land hunger again The growth of the cloth industry increased the demand for wool and made it profitable for the landowners to turn farmlands into pasture They fenced in ("en- closed") the pastures with hedgerows 'Where 40 per sons had their livings,' the laborers complained, "now one man and *his shepherd hath all*" *Men* thrown out of work by the enclosures became vaga- bonds and terrorized the townfolk Whipping the "*sturdy beggars' failed to solve the problem*
Throughout the Middle Ages the monasteries had given alms to the poor Now that the monasteries *were no more the government took over the task* Elizabeth's famous statute of 1601, an Act for the Relief of the Poor required every parish to levy *rates* (local taxes) for poor relief Children were to be put out as apprentices if their parents could not support them Wages of artisans and farm laborers were fixed by law All able bodied men were com pelled to work They could no longer move freely from place to place They were practically serfs again except that they had no rights in the land

Birth of the British Empire

The Tudor dynasty came to an end when Elizabeth I died in 1603 The crown of England then passed to the Stuart line of Scotland (*see* Stuart) The new king was called James VI in Scotland and James I in England The two countries, having the same ruler, were now bound together in a personal union, but they continued for another century to have separate parliaments
James boldly announced that he would rule as an absolute monarch responsible to God alone This view of monarchy was called the *divine right of kings*

It was generally accepted on the continent of Europe, but it ran counter to the nature of the English people. Parliament resisted James at every point. By insisting that all people conform to the Church of England, he won the enmity of the Puritans, the most extreme of the English Protestants, as well as the Catholics. A small band of Catholic extremists, including Guy Fawkes, formed the Gunpowder Plot to blow up king and parliament together (*see* Fawkes). Yet on the whole James's reign was quiet. His son Charles was to face the bitter reckoning.

James allowed the navy to decay and suppressed privateering. Yet it was in his reign that colonial expansion began and the British Empire was born. The colony of Jamestown, Virginia, was started in 1607. In 1620 the Pilgrims landed on the rocky shore of New England. Other colonists swiftly followed. Some went to escape religious persecution and some to find free land. With ax and plow they spread English civilization into the wilderness. (*See also* American Colonies; British Commonwealth and Empire.)

Under Charles I, who ruled 1625–49, active colonization continued. Charles was glad to have the troublesome Puritans leave England and put no bars on their emigration. Wealthy Puritan lords and London merchants backed the Massachusetts colony. Great wealth flowed into London from American tobacco, the African slave traffic, and the silks and spices of India. Trading companies built their own fleets and "filled the nation with great ships and expert mariners."

England's Civil War

Charles was as obstinate a despot as his father. In 1629 he dissolved Parliament, determined to rule by himself alone. Eleven years later he became involved in a war with Scotland and was obliged to summon Parliament to raise money for his armies. When Parliament refused to vote the money, Charles dissolved it. Before the year ended he summoned it again. This time Parliament forced the king to agree not to dissolve it without its consent. It lasted, with some interruptions, from 1640 to 1659 and is known as the Long Parliament.

Puritans dominated the House of Commons. Instead of aiding the king, they passed laws to curb his power. The king went in person to the House, determined to arrest five of its leaders, but "the birds had flown." Parliament issued a call to arms, a revolutionary act. The powerful new middle class put its great resources behind the Puritans. The king rallied the royalist aristocracy, high church Anglicans, and the Catholics to his standard.

The Parliamentary army went into battle singing psalms. In 1644 the Puritans defeated Charles's "Cavaliers" at Marston Moor. In this battle Oliver Cromwell, the Puritan leader, won the name "Ironsides" The next year he gained a decisive victory at Naseby.

In 1648 Colonel Pride, a Puritan, stood at the entrance of the Commons with a force of soldiers and allowed only "Roundheads" to enter. (The Puritans were called Roundheads because they cut their hair short. The Cavaliers wore long flowing locks.) The group that remained after "Pride's Purge" was called the "Rump Parliament."

The Rump sentenced Charles to execution, and he was beheaded Jan. 30, 1649 (*see* Charles I). The Rump then declared England a Commonwealth (that is, a republic), without a king or a house of lords.

The Commonwealth and the Protectorate

The Rump Parliament governed England while Cromwell put down revolts in Ireland and Scotland with extreme cruelty. In 1653 the vigorous leader of the Revolution came back from the wars, turned Parliament out of doors, and "nominated" a Parliament of his own (called "Barebone's Parliament" after one of its members, Praise God Barebones). The Commonwealth then took the name of Protectorate, with Cromwell as Lord Protector (*see* Cromwell).

The Puritans closed the theaters, suppressed horse racing, cockfighting, and bear baiting, and made Sunday strictly a day of worship. Cromwell's military

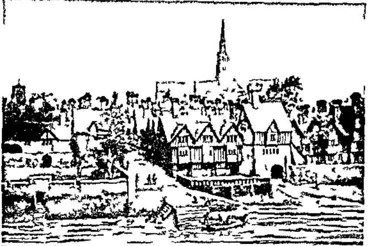
HAMPTON COURT PALACE

Hampton Court is a fine example of Tudor brick architecture. Cardinal Wolsey built it and lived here in such great state that Henry VIII became envious, and the cardinal thought it wise to make the king a present of it (1525). Additions by Christopher Wren, in the 18th century, made it the largest palace in England. It stands on the Thames and is surrounded by beautiful gardens.

rule was more despotic than that of the king. Yet the revolution accomplished its purpose. When the monarchy was revived it was a limited monarchy. The Church of England, when it was restored, never again tried to include every person in England.

Barebone's Parliament made the office of protector hereditary. When Cromwell died in 1658 his eldest son, Richard Cromwell, became Lord Protector. Too weak to control the army on which the Protectorate rested, "Tumbledown Dick" resigned the next year. In 1660 George Monk, one of Cromwell's generals, came down from Scotland with an army and had the Rump of the Long Parliament recalled in order to dissolve itself. A new Parliament could then be legally elected. It at once offered the crown to the son of *Charles I*, who had been safe in France when his father was beheaded.

THE LONDON THAT SHAKESPEARE KNEW



These charming half-timber houses were typical of the Elizabethan period. The street ends at Blackfriars Stairs, from which a ferryboat carried passengers across the Thames. In the background is old St. Paul's, destroyed in the Great Fire of 1666.

England under the Restoration

The people of London joyously welcomed Charles II when he arrived from France with the gay court of Cavaliers that had been exiled with him (*see* Charles *II*). The bleak Puritan age was suddenly ended. Theaters opened again. Footlights, curtains, and *painted* scenery were introduced. For the first time women appeared on the stage. Restoration dramatists delighted Londoners with sparkling comedies that laughed at Puritan virtues. John Dryden, poet laureate, best represented the Restoration period. Its greatest poet, however, was still the Puritan John Milton, who had faithfully served Cromwell. Now blind, he retired from public life to write the greatest epic in the English language, 'Paradise Lost'. (*See also* Dryden; Milton; Drama; English Literature.)

England's greatest architect, Sir Christopher Wren, rebuilt St. Paul's Cathedral following London's Great Fire of 1666 and designed scores of parish churches (*see* Wren, Christopher). Science flourished along with the arts. Isaac Newton formulated laws of the universe and spread the spirit of scientific inquiry (*see* Newton). An observatory was established at Greenwich.

Catholics fared somewhat better than Puritans under Charles II. His Cavalier Parliament in 1662 passed an Act of Uniformity depriving all clergymen of their offices who did not accept everything in the Anglican Prayer Book. This act tended to throw all nonconformists (Independents, Presbyterians, Baptists, and the new Quaker sect) into a single class called dissenters. To make things easier for Catholics Charles issued a Declaration of Indulgence in 1672. Parliament forced him to retract this and passed a Test Act (1673), which made it impossible for Catholics to hold public office.

The Birth of Political Parties

Charles II leaned toward Catholicism. His brother James, heir to the throne, was an avowed Catholic. In 1679 an "Exclusion Bill" was presented in Parliament to bar James from the kingship. Charles prevented its passage by dissolving Parliament. The governing classes at once split into bitter factions—the Tories, who opposed the bill, and the Whigs, who favored it. Thus were born the first great political parties in history.

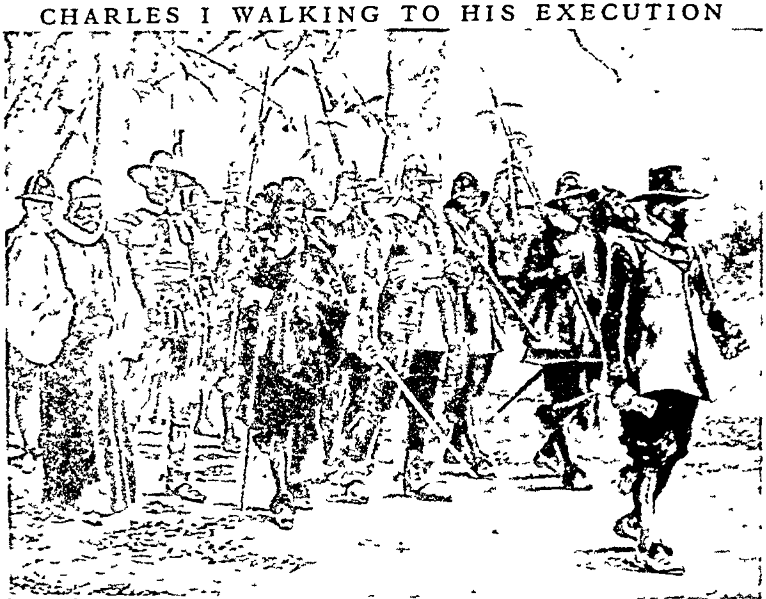
The names *Whig* and *Tory* were both terms of derision. Tory was Irish slang for a "popish" outlaw. Whig was a term of contempt in Scotland for a fanatic Presbyterian. The Tories descended from the Cavaliers, represented the landed aristocracy. They upheld the divine right of kings and the Anglican church. The Whigs descended from the Roundheads, represented the commercial classes of the cities. They championed Parliament against the king and urged toleration for nonconformists.

Following the decline of Spanish and Portuguese sea power the Dutch Netherlands became a serious rival of England in the Far East, in Africa, and in America. In the 17th century England fought three commercial wars against the Dutch (1652–54, 1665–67, and 1672–74). The Netherlands then dropped out of the race for world commerce and American dominions. In the third war the English joined forces with the French—not yet aware that France was to be the next rival England had to face.

The "Glorious Revolution" of 1688

Charles II died in 1685, and his brother James II stepped quietly to the throne. However, when a son was born to James in 1688 Tory and Whig leaders joined together and decided to set aside the

CHARLES I WALKING TO HIS EXECUTION



During England's Civil War, a Puritan parliament brought Charles I to trial and convicted him of treason to the state. Here we see him in the ornate dress of a Cavalier, walking to Whitehall, where he was beheaded (1649). A Puritan leads the procession.

Catholic line of kings. They invited Mary, a daughter of James, and her Dutch husband, William of Orange, to occupy the throne as joint sovereigns. When William arrived from Holland, James fled to the continent. He had reigned only three years. (*See also* James II; William III; Mary II.)

Parliament was careful to lay down conditions for the new sovereigns. William and Mary accepted its Declaration of Rights, and Parliament speedily enacted it into law as the famous Bill of Rights (*see* Bill of Rights). The act made the king responsible to Parliament and subject to the laws and provided that henceforth no Roman Catholic could wear the crown of England. Parliament, and not inheritance or divine right, would determine the succession to the throne. This was the fruit of the so-called "Glorious Revolution"—a revolution without bloodshed.

John Locke published a defense of the Revolution in which he boldly proclaimed the supremacy of the legislative assembly as the voice of the people. In the next century this became a textbook of American revolutionists (*see* Locke).

England's Long Struggle with France

While England was in the throes of revolution, France under Louis XIV, was achieving a dominant position in Europe. With internal conflict ended, England turned its attention abroad. In 1689 it joined with Holland and several German states in the War of the Grand Alliance against France. The war was fought on land and sea and spread to America, where it was called King William's War. It marked the beginning of a long struggle to decide whether France or England was to control India and North America. (*See* King William's War.)

When William died, in 1702, Louis XIV proclaimed James Stuart, son of James II, king of England, Scotland, and Ireland. Parliament, however, had already provided that, if William and Mary had no children, the crown should pass to Anne, a Protestant, daughter of James II by his first wife. James Stuart kept up his claim to the throne for 65 years and became known as the Old Pretender. His son, Bonnie Prince Charlie, known as the Young Pretender, made an unsuccessful attempt to obtain the throne in 1745 (*see* Pretender).

As soon as Anne came to the throne in 1702, England entered upon another war with France to break up a threatened combination of France and Spain. This was called in Europe the War of the Spanish Succession. In America it was known as Queen Anne's War. The Duke of Marlborough led the English, Dutch, and Germans to brilliant victories, and the Treaty of Utrecht (1713) gave England important territories (all Nova Scotia and Newfoundland) in the New World. (*See also* Queen Anne's War; Marlborough.)

Birth of the Kingdom of Great Britain

THE MOST notable event of Anne's reign was the union of England with Scotland. Since 1603 the two countries had been loosely associated under the same king. In 1707 the Parliaments of England and Scotland passed an act of Union joining the two nations under the single Parliament in London, with the name Great Britain. After this date, it is inaccurate to speak of the parliament or government of Britain as English. (*See also* Scotland; Great Britain; Flags.)

Britain's First Prime Minister

The Stuart line came to an end when Anne died, since none of her 17 children survived her. She was succeeded in 1714 by the nearest Protestant heir, George I, a prince of the House of Hanover, a small state in Germany. (*See* Hanover; George I.) George did not speak English, and he was so wrapped up in his beloved Hanover that he took little interest in British affairs. He soon began to stay away from meetings of his inner council, or cabinet, and left the government in the hands of Sir Robert Walpole, the able Whig leader. George II, who ruled 1727–60, also stayed away from meetings of his ministers. Walpole made himself supreme in the government, selected his colleagues, and insisted they work with him or leave the cabinet. He thus became the first prime minister. (*See also* George II; Cabinet.)

Walpole promoted trade and commerce and strove to avoid war But in 1739 the British people became aroused over the story of Robert Jenkins a sea captain who claimed the Spaniards had boarded his ship and cut off his ear Walpole was persuaded to declare war against Spain in 1739—the War of Jenkins Ear He resigned when this war merged into another continental war the War of the Austrian Succession in America called King George s War (*see* King George s War Austria Hungary) When peace was made in 1748 the real issue—whether France or Britain was to prevail in India and North America was still unsettled

The struggle with France was renewed in the Seven Years War which broke out in 1756 This war brought to the fore a leader of genius William Pitt earl of Chatham He carried on the struggle against France in America Africa and India as well as in Europe and on the sea The war cost France almost all its territory in North America and India and vastly extended Britain s empire Horace Walpole wrote to Horace Mann in America You would not know your country again You left it a private little island living upon its means You will find it the capital of the world (*See also* Chatham Seven Years War French and Indian War British Commonwealth)

The American Revolution

Before the Seven Years War ended George III began his 60-year reign 1760–1820 Determined to be a king and quite unfit to be one he got rid of Pitt and put his own Tory friends in power

The Tory government imposed new taxes on the American Colonies The colonists insisted the British Parliament had no right to tax them without their consent Pitt and Edmund Burke counseled compromise (*see* Burke) but George III and his ministers obstinately insisted on their course Troops were sent to enforce the decrees and the colonists met force with force On July 4 1776 the American Congress adopted a Declaration of Independence Two years later France entered the war on the side of the colonists The Americans won their independence and Britain lost the most valuable part of its colonial empire (*See also* Revolution American Declaration of Independence Stamp Act)

George III s attempt at personal rule was now completely discredited Parliament regained its leadership William Pitt second son of the earl of Chatham became prime minister in 1783 and held the position for 17 years (*See also* George III Pitt)

Britain s Classical Age

The numerous wars of the 18th century were fought with small professional armies and hardly disturbed the even tenor of life in the fortunate isle Even the loss of the American Colonies was little felt Britain was still mistress of the seas and its mariners and traders soon built a second empire greater than the old Before the century ended the French Revolution and the Industrial Revolution were to produce tremendous upheavals Until the storm broke Britain was quiet and settled

The years 1740–80 were Britain s classical age —an age of art and elegance of enlightment and religious tolerance Wealth and leisure became more widely diffused In town and country the middle class put up comfortable dignified homes in the Queen Anne and Georgian styles Into them went furniture designed by Thomas Chippendale Thomas Sheraton and the Adam brothers and beautiful china glass and silver plate made by skilled English handcraftsmen

THE COFFEEHOUSE A CENTER OF SOCIAL LIFE

Hundreds of coffeehouses sprang up in London in the 18th century to serve the new drink brought in by ships of the East India Company Every well to-do Londoner had his favorite house In some writers and critics gathered in others politicians or businessmen Ladies were not invited Courtesy of the British Museum painting by Walter A Curtin.

The dress of the age was extravagant. Men wore bright-colored silk coats, waistcoats, and breeches; women appeared in hoop skirts and elaborate headdresses or high pompadours. The three great portrait painters of the age—Reynolds, Gainsborough, and Romney—pictured the fashionable aristocrats while Hogarth caricatured both the fashionable and the common people. Alexander Pope, a bitter satirist, was the leading poet of the age; but the most characteristic literary figure was Samuel Johnson, who gathered with other writers in London's coffeehouses to discuss and debate. (*See also* Interior Decoration; Furniture; Painting; English Literature.)

The government was little concerned with reform. Individuals, however, were showing a growing sensitiveness to the wretched condition of the poor. Hundreds of charity schools, Sunday schools, and hospitals were founded, all at private expense. John Howard made prison reform his life's work (*see* Prisons). William Wilberforce set in motion a campaign that was to free the slaves in all the British colonies by 1833 (*see* Slavery). The new humanitarian spirit was quickened by the Methodist movement, a tremendous religious revival led by John Wesley (*see* Wesley).

The Industrial Revolution

Under the quiet surface of the classical age, Great Britain was entering upon the greatest revolution in all history—a revolution that was to spread over all the world. It began with inventions in the textile industry—John Kay's flying shuttle, to speed up weaving, and Hargreave's spinning jenny, for making yarn. These inventions transformed the textile industry, which had seen almost no change for thousands of years. By 1781 James Watt had developed a steam engine to run these and other machines. During the next 15 years cotton manufactures trebled. The great Industrial Revolution was under way. (*See also* Industrial Revolution; Hargreaves; Watt.)

The revolution in agriculture also began in the 18th century. In the time of Queen Anne, British landowners began to devote their wealth and personal attention to improving methods of cultivation. On their enclosed fields they practiced scientific rotation of crops and pasture and new methods of draining, drilling, sowing, and fertilizing. They began to grow root crops (turnips and potatoes) in fields instead of in small gardens. By selective breeding and proper winter feeding of stock they doubled the average weight of cattle and sheep. Fresh beef and mutton replaced salted meat in the winter diet. Scurvy and other skin diseases, prevalent in earlier centuries, grew rare even among the poor. The increasing knowledge of medicine combined with better nutrition to bring about a sharp drop in the death rate—from 33 in a thousand in 1830 to 23 at the end of the century (*see* Vaccination; Health). As a consequence population increased enormously.

Great improvements in inland transport accompanied the revolutions in industry and agriculture. In Queen Anne's reign coal was still carried on pack horses. Roads were so poor that wheels stuck in the mud or broke on hard, dry ruts and huge stones. The government still took little interest in road building. Private initiative supplied the need. Turnpike companies laced the land with roads and made their profit by collecting fees at toll gates. Heavy wagons lumbered over the new turnpikes, and light stagecoaches sped along them at ten miles an hour, stopping at coaching inns for new relays of fast horses. In 1750 a great era of canal building began. Before the end of the century the land was interlaced with a network of waterways. Like the roads, the canals were built for profit by private companies.

THE INDUSTRIOUS AND THE LAZY APPRENTICE

Weaving was still a cottage industry when William Hogarth engraved this picture about 1747. The master, at the door, has his eye on Tim Idle, who is asleep at his loom. Apprentices lived in the master's house while learning a trade.

Britain's threefold revolution was accomplished by private initiative. Individualism, the spirit of the age, freed men's minds and energies. Yet many government restrictions still shackled industry and commerce. Adam Smith, creator of the science of political economy, called attention to the harmful effect of these restrictions. Complete freedom of industry and trade, he said, would unleash even greater productive energy. His ideas, published in 'Wealth of Nations' (1776), gave directions to the new age of industrial development.

The Challenge of Napoleon

The outbreak of the French Revolution ended the harmony of 18th-century Britain. Class faced class in bitter con-

troversy Thomas Paine upheld the revolutionists in a stirring appeal to the masses The Rights of Man Edmund Burke eloquently voiced the attitude of conservative Englishmen The French he said have shown themselves the ablest architects of ruin who have hitherto existed in the world (*See also* Burke Paine)

People were horrified when France set up a republic and executed Louis XVI George III went into mourning and expelled the French envoy France declared war and Britain promptly joined the coalition of European monarchs against the new French republic (*see* French Revolution) The war dragged on without much result until the young general Napoleon Bonaparte began to win amazing victories for the French By 1797 Britain was left to carry on the war alone

CANVASSING FOR VOTES

In this engraving Hogarth satirizes 18th century politics A candidate s agent offers trinkets to women and asks them to see that their husbands vote the right way

Britain was weak on land but supreme on the sea Admiral Nelson s great victory of the Nile (1798) gave the British navy control of the Mediterranean and made the route to India secure At Trafalgar (1805) Nelson annihilated the French fleet (*see* Nelson) Napoleon victorious on the continent was unable to invade the island kingdom He therefore sought to ruin the race of shopkeepers by forbidding Europe to trade with Britain Britain countered by blockading all European ports controlled by Napoleon The United States exasperated by Britain s interference with its commerce declared war on Great Britain in 1812 (*see* War of 1812)

Britain meanwhile had built up an army led by the Duke of Wellington Wellington first drove the French out of Spain In 1815 he commanded the British forces at the memorable battle of Waterloo which destroyed Napoleon s army Before the year ended a British ship carried off Napoleon to an island prison (*See also* Wellington Napoleon I Waterloo)

Effects of the War with France

Triumph over France brought Great Britain national glory and financial profit The empire expanded and British control over sea routes was made secure The increased demand for British goods stimulated commerce and quickened the pace of the Industrial Revolution British blast furnaces and textile mills supplied munitions and clothes not only for the armies of Great Britain but for its allies as well

English poetry reached the highest point it had touched since the age of Shakespeare The ideas of the French Revolution ended the Classical Age on the continent as well as in Britain and gave birth to a new back to-nature movement in art and literature called the Romantic Movement The Romantics extolled emotion as the Classicists had reason and sought the beautiful in nature or in medieval art rather than in classical models (*See also* English Literature Painting section List of Terms)

Changes appeared also in dress and morals Women ceased to powder their hair Men discarded wigs and cut their hair short Wool and cotton began to replace silks satins and velvets for both men and women The reformers of the age sent missionaries into foreign lands but they took little interest in the increasing wretchedness of Britain s poor

The war swelled the fortunes of landlords merchants and manufacturers To the poor it brought misery Men and women toiled 12 to 18 hours a day in mines and factories Wages were at starvation levels Child labor was widespread *Laissez faire* (let it alone) was becoming the order of the day in industry The new freedom unfortunately did not extend to the working classes They were forbidden to hold meetings to organize unions even to publish pamphlets When workers rioted and smashed the new machines the government made machine breaking a capital crime Fourteen Luddites (so called from a feeble-minded youth who destroyed two stocking frames) were put to death in Yorkshire in 1811

Inspired by the revolt of the French peasants the Irish rose against English rule in 1798 In 1800 Pitt succeeded in bringing Ireland into a union with Great Britain similar to that between England and Scotland The Act of Union went into force Jan 1 1801 creating the United Kingdom of Great Britain and Ireland (*see* Great Britain Flags) The mass of the Irish however, being Catholics were still ex-

cluded from the government. George III allowed only Church-of-England Irish to sit in Parliament.

The Coming of Democracy

The factory system made tremendous changes in the social structure. Two new classes had appeared—the capitalists, or *entrepreneurs*, who owned the factories and machines, and the mass of the workers, who were dependent on the capitalists for employment. Large manufacturing cities had risen in the north, close to the coal fields. Many of these cities had no representation in Parliament because since the time of Charles II no new "boroughs" had been created to send up members. In the south of England Tory proprietors of boroughs with few or no inhabitants (called "pocket boroughs" or "rotten boroughs") continued to send representatives. Cornwall sent as many members to the House of Commons as all Scotland.

The spirit of reform was gradually making itself felt. Jeremy Bentham, called the *utilitarian*, made "utility" the test of law and said government should promote "the greatest happiness of the greatest number" by scientific legislation. Philosophic radicals such as James Mill advocated a *laissez-faire* individualism. Robert Owen showed in his New Lanark mills in Scotland that good hours, good wages, and healthy factory conditions could be made to pay.

William Cobbett, a radical journalist, led a campaign for universal suffrage because he believed workmen could improve their condition only by achieving the right to vote. The great industrial city of Manchester had no parliamentary representation. In 1819 a crowd of 60,000 assembled on St. Peter's Field to choose a "legislative representative." Mounted soldiers charged into the crowd, killed 11 persons, and wounded many. This "Peterloo Massacre" aroused great indignation and gave the death blow to the old Toryism.

George III became insane in his later years and blind as well. For nine years before his death his incompetent eldest son governed as prince regent. (This period, 1811–20, is therefore known as the Regency.) On his father's death, the prince regent became King George IV. (*See* George IV.)

The more progressive Tories now began a series of reforms that opened a new era. Trade unions were partially legalized in 1825. Catholics were admitted to Parliament—after a struggle of many years—by the Catholic Emancipation Act of 1829. Harsh criminal laws were reformed, reducing capital offenses to about a dozen. (In 1800, 200 offenses had been punishable by death.) In 1829 Robert Peel set up, for the first time in history, a civilian police force. Started in London, it spread quickly to other cities. The people called the police by either of Peel's names—"bobbies" or "peelers" (*see* Peel).

William IV, brother of George IV, began his short reign in 1830 (*see* William IV). The "reform" of parliament had by now become the burning issue. Extreme Tories, led by the Duke of Wellington, stood fast against it. Reform groups in Parliament, including the moderate Tories, drew together and supported Earl Grey, the Whig leader. Wellington's government fell and the Whigs came into power. Lord John Russell introduced a strong reform bill. In the face of tremendous opposition in the House of Lords, the Great Reform Act was passed in 1832. (*See also* Wellington; Russell.)

The Reform Act created 43 new boroughs and deprived the "rotten boroughs" of their representatives in Parliament. The battle for universal suffrage, however, was still to be fought. The Reform Act slightly increased the number of voters by lowering the property qualifications; but the mass of the working people were still too poor to vote.

During the 1830's the Tories dropped their somewhat discredited name and became known as the Conservative party. The free-trade Conservatives (Peelites) gradually merged with the Whigs, who were to become the new Liberal party. Liberalism in the 19th century meant individualism. The true Liberal of that day championed freedom of thought and religion, freedom of trade, freedom of contract between the individual employer and the individual workman, and unrestricted competition. The party was made up chiefly of the industrial middle class.

The Victorian Age

William IV died in 1837, in the seventh year of his reign, and Victoria, his 18-year-old niece, became queen of Great Britain. Three years later she married her cousin Albert, a German prince. As prince consort, Albert gave valuable aid to the queen until his death in 1861. (*See* Victoria, Queen.)

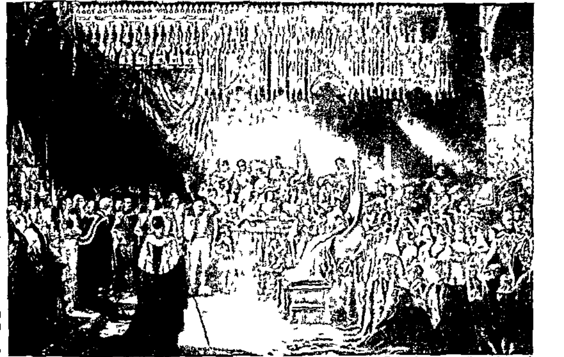
The young girl entered eagerly upon her new duties. Her long reign, 1837–1901, was to be immensely creative in literature and science, and before its close Britain reached the first place among nations in wealth and power. In the first years of her rule, however, the country seemed to be almost on the verge of revolution.

A series of bad harvests, beginning in 1837, continued into the "Hungry Forties." England suffered a wheat famine, Ireland a potato famine. A high tariff on grain (called "corn" in England) kept out foreign wheat. The price of bread soared. A new Poor Law (1834) had ended the outdoor relief for paupers that had been begun in the time of Queen Elizabeth I. The workhouses that took their place (described in Dickens' 'Oliver Twist') were more dreaded than jails. Wages were miserably low. A tremendous migration began from the British Isles to Canada, Australia, New Zealand, and the United States.

A group of reformers called *Chartists* drafted in 1838 a bill called the People's Charter, calling for universal manhood suffrage. Armed with guns and pikes, the Chartists held mass meetings on the moors by torchlight. The government tried and sentenced hundreds of the leaders.

Meanwhile an Anti-Corn Law League had been formed in 1836, to campaign for the free entry of foreign wheat to feed the hungry poor. John Bright and Richard Cobden led the fight against the "bread tax." Sir Robert Peel, the Conservative prime minister, was finally converted to their view; and in 1846 he

THE CORONATION OF QUEEN VICTORIA



Victoria was a girl of 18 when she came to the throne in 1837 Before her long reign ended Britain had become the workshop of the world as well as its banking house and had reached a peak of wealth and power

put through Parliament the famous bill repealing the Corn Laws Wheat at once poured in from overseas Prosperity returned even for the farmers

With bread cheap the working people began to lose interest in the Charter They now began to turn their attention to the new trade unions and to the co-operative movement started in 1844 by the Rochdale Pioneers (*See also* Peel, Cooperative Societies)

The success of the Corn Law repeal encouraged the government to remove the tariff on other foods and on the raw materials needed by manufacturers With free trade Britain entered upon its period of greatest prosperity Iron and steel output expanded greatly Steam and machinery came to be used increasingly in every kind of manufacturing process Before 1850 many old posting inns and public mail coaches had disappeared, owing to a tremendous boom in rail way building By 1848 a large part of the trackage was paralleled with telegraph wires "Penny postage" introduced throughout the British Isles in 1840, provided a cheap and uniform postage rate prepaid by an adhesive stamp (*see* Post Office) British commerce was set free in 1849 by the repeal of the old Navigation Laws which permitted only British ships to carry goods between different parts of the empire The application of steam power to ocean-going vessels stimulated the growth of the merchant marine and the navy Commerce expanded enormously In 1851 the country celebrated its industrial progress in the first great international fair called the Great Exhibition (*see* Fairs and Expositions) The government began to take more interest in the empire which provided the manufacturers with both markets and raw materials The Crimean War (1854–56) was fought to protect British and French imperial interests against Russia's threatened advance toward the Mediterranean and India (*see* Crimea) After helping the British East India Company put down the Sepoy Rebellion in India (1857) Parliament deprived the company of its political powers and transferred the government of India to the British Crown (*see* India)

The Roman Catholic hierarchy of archbishop bishops and priests was permitted in Britain in 1850 for the first time since the death of Mary I in 1558

Reform and Imperialism

The Reform Act of 1832 had benefited only the middle class In 1867 Parliament took another long step in the direction of democracy by putting through the second Reform Act This gave the vote to almost all adult males in the towns The bill had been introduced by Benjamin Disraeli a Conservative Nevertheless the new voters many of them workingmen supported William Gladstone, Liberal leader With Gladstone s first and greatest ministry, 1868–74 an era of reform set in (*See also* Gladstone)

The Education Act of 1870 set up elementary schools financed in part by the government In the same year competitive examinations were introduced

for employment in the civil service. The Trade Union Act of 1871 gave full legal recognition to trade unions. In 1872 the secret ballot was introduced in parliamentary elections.

Imperialism came into the ascendancy in 1874 with Benjamin Disraeli's Conservative ministry (see Disraeli). Disraeli obtained for Britain financial control of the Suez Canal, key to Britain's eastern empire (*see* Suez Canal). In 1876 he had Queen Victoria declared empress of India. When Russia defeated Turkey and advanced close to Constantinople, he called the Congress of Berlin (1878), which checked Russian ambitions (*see* Berlin, Congress of).

Gladstone's second ministry, 1880–85, carried through a third Reform Bill in 1884. This gave rural voters the same voting privileges as the townspeople. In both his third and fourth ministries the "Grand Old Man" went down to defeat because he championed Home Rule for Ireland (*see* Gladstone).

The Irish question split the Liberal party into Home Rulers and Unionists. The Liberal Unionists, led by Joseph Chamberlain, gave their support to the Conservative party because they wanted no separate parliament for Ireland (*see* Chamberlain, Joseph). The result was a coalition of Conservative and Liberal Unionists, which remained in office almost continuously for 20 years.

During the three ministries of Robert Salisbury, the government brought the navy to a high state of efficiency and secured for Britain the lion's share in the partition of Africa. To stimulate interest in the empire, it celebrated the 50th and 60th years of Victoria's rule (1887 and 1897) with magnificent "jubilees" attended by Indian princes and representatives of all the far-flung dominions and colonies. Before the century ended, the British were engaged in the Boer War (1899–1902) against the Dutch farmers (Boers) in South Africa. After some humiliating defeats, Britain won the war and annexed the two Boer republics, the Transvaal and the Orange Free State. Following annexation, Britain granted self-government to South Africa under the leadership of Jan Smuts, a Boer. (*See also* Boer War; Smuts.)

Before the Boer War was over, Queen Victoria died (1901), ending the longest reign in British history. Edward VII, her son, succeeded her.

An Age of Peace and Progress

The Victorians called their age "modern" and thought it superior to all past centuries. It was an age of progress with peace and plenty. Since Waterloo (1815) England had taken part in no great war. Food, clothing, and furniture were more abundant than in any previous century. Wages and working conditions steadily improved. Dividends from British industry and from foreign investments supported a leisure class. Despite a falling birth rate, the population of the United Kingdom increased in the last half of the century from 28 million people to nearly 42 million.

The age was extraordinarily creative in literature and science. The poets Tennyson and Browning expressed the Victorians' optimism and religious feeling. But it was chiefly an age of the novel, represented by Thackeray and Dickens, and the essay (*see* Novel; English Literature). In pure science, Charles Darwin's theory of evolution had world-wide influence (*see* Darwin). Great progress was made also in the physical sciences and in medicine.

The Victorians did not excel in music or in painting. Architecture actually deteriorated, owing in part to the progress in technology that caused a breakdown of craftsmanship and tradition. Cheap manufactured knicknacks cluttered Victorian parlors. William Morris, poet and craftsman, led a revolt against ugliness, advising people to "have nothing in your house except what you know to be useful or believe to be beautiful" (*see* Morris, William).

The Labor Party and the New Liberalism

When Edward VII came to the throne, in 1901, dark clouds were visible on the horizon. Britain was no longer the only "workshop of the world." The Industrial Revolution, which had started in Britain, was now in full swing in other countries. Germany, the United States, and Japan competed strongly with Britain in foreign markets. Unemployment soon became chronic on the small, thickly populated island. Serious unrest stirred the working classes.

Germany not only competed with British industry but had become the greatest military power on the continent; and in 1900 it began to expand its navy, challenging British control of the seas. To meet this threat, Britain abandoned its "splendid isolation" and entered into an alliance with Japan in 1902. In 1904 it concluded the *Entente Cordiale* with France, and in 1907 it reached a similar agreement with Russia. (*See also* Edward VII.)

In 1900 the British trades union federation, called the Trades Union Congress, held a conference to form a new political party. Delegates were invited from various socialist organizations. Chief among these was the Fabian Society. The Fabians were a group of middle-class intellectuals who had been advocating national ownership of land and industry since 1883 (*see* Socialism). The new party was formed and became known at once as the Labor party.

Fabian teachings had been spreading also in the Liberal party. The "new" Liberals of the 20th century no longer stood for *laissez faire* ("let it alone") in government. They had turned against individualism and "classical" economics and favored extending the powers of the state to abolish poverty. They still, however, held to the 19th-century Liberal doctrine of free trade. On this issue they won a large majority in the election of 1906. Labor party representatives supported the Liberal program of far-reaching social legislation.

Lloyd George's Social Legislation

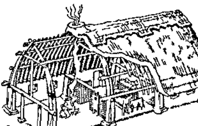
The driving power of the new government was David Lloyd George, chancellor of the exchequer under Herbert Asquith from 1908 to 1916 (*see* Lloyd George). In 1908 he put through Parliament an Old Age Pensions Act granting pensions entirely at government expense to all old people with a small

THE CHANGING SHAPE OF THE ENGLISH HOUSE

1

1 DUGOUT HUT PREHISTORIC

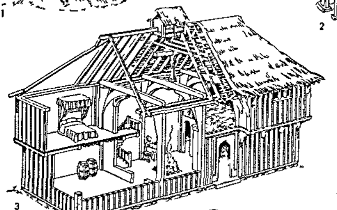
This house is all roof Poles stuck in the ground meet at a center pole to form a cone Dirt from in side is scooped out to make more head room and p ed up around the poles to keep them from slip-p ng The poles are interlaced with brushwood and covered with sod Smoke from the hearth escapes through an opening at the top



2

2 CRUCK HOUSE (ANGLO SAXON)

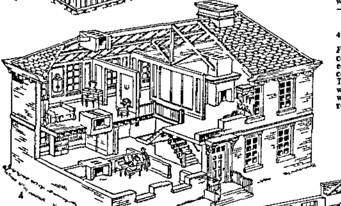
This house takes its name from curved timbers called crucks arranged in pairs to support a r dgepole (A pair of crucks could be obtained by sp ting a bent tree) Four pairs of crucks g ve *this house three rooms—two for farm animals and* one for the farmer and his family The roof is thatched Houses of improved cruck construction were built until the 18th century



3

3 TIMBER FRAME HOUSE (15TH CENTURY)

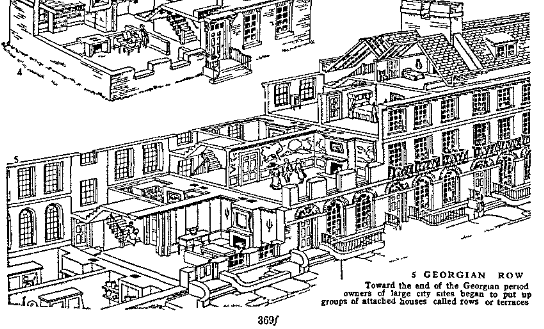
Wall frames with wooden upr ghts (studs) support a roof truss The floor beams of the second story *rest on the first-story wall frame They project* outward about two feet in order that weights on the floor will be balanced by the weight of the walls resting on the overhang or jetty The wall frames are filled in with wattle and daub —mud reinforced with wooden slats



4

4 GEORGIAN HOUSE (18TH CENTURY)

From Italian architects the English learned to construct a house of beautiful proportions two or even three rooms deep The usual plan was a central hall flanked on each side by two rooms Thick brick walls inside and outside support the weight of the floors and roof Georgian houses were built in both town and country during the reigns of Queen Anne and the first four Georges



5

5 GEORGIAN ROW

Toward the end of the Georgian period owners of large city sites began to put up groups of attached houses called rows or terraces

THE RUINS OF COVENTRY CATHEDRAL

In a single night (Nov. 14, 1940) German bombers destroyed the heart of the ancient city of Coventry. Only the outer walls and steeple remain of the 14th-century cathedral (St. Michael's). More than 60,000 houses were damaged or destroyed.

income. On Jan. 1, 1909, over half a million men and women drew their first pensions.

Pensions and the constantly expanding navy vastly increased the expenses of government. In 1909 Lloyd George proposed heavy taxes on the wealthy and a new tax on land. The House of Lords rejected his budget. A constitutional struggle took place that ended in the Parliament Act of 1911, which stripped the House of Lords of much of its power (*see* Parliament). The way was now open for the passage of a National Insurance Act (1912) to pay wage earners unemployment and sickness benefits.

In the midst of the parliamentary struggle Edward VII died (1910). He was succeeded by his only surviving son, George V (*see* George V).

The First World War and Its Aftermath

On the eve of the first World War the British people were concerned with militant suffragettes, workingmen's strikes, and an Irish crisis (*see* Women's Rights; Ireland). War broke out with startling suddenness on Aug. 1, 1914. Britain declared war three days later, and the British dominions and colonies were automatically drawn in. British and empire troops fought in France and Belgium, at Gallipoli, and in Palestine, while the British navy held the seas and prevented ships with food and supplies from reaching Germany. (*See also* World War, First.)

Lloyd George became the war leader in 1916 when he succeeded Asquith as head of the Nationalist government, a coalition of Liberal and Conservative parties. He was returned to office in 1918, when the Nationalists gained an overwhelming victory at the polls. The peace treaties, which he negotiated, added more territory to the vast British Empire in Asia, Africa, and the Pacific (*see* World War, First, section "The Peace and Its Results"). The United Kingdom itself, however, was made smaller by an act of Parliament granting self-government to southern Ireland as a dominion of the British Commonwealth (*see* Ireland; Great Britain).

In 1918 Lloyd George's government passed an Education Act abolishing all fees in state-supported elementary schools. The same year it extended manhood suffrage and granted the right to vote to single women over 30 and married women over 35 who met certain property qualifications. In 1919 women became eligible for Parliament.

The war had vastly increased the national debt. By imposing heavy income taxes, the government managed to balance the budget while increasing payments to unemployed. Industrial peace, however, did not return. After a few years of prosperity, exports declined and unemployment rose. A wave of strikes engulfed the country.

The Conservatives deserted the Nationalist coalition and inflicted a crushing defeat on the Liberals in the election of 1922. Their victory, however, was short-lived. The Labor party (which had come out openly for socialism in 1918) voted with the Liberals to turn out the Conservatives, and in 1924 Ramsay MacDonald was chosen to head Britain's first Labor government. He remained in office only nine months, going down to defeat partly because he advocated closer relations with Soviet Russia.

Under Stanley Baldwin as prime minister, the Conservatives returned to power for almost five years (1924–29). Again unemployment relief was increased. The people looked on it as poor relief and called it the "dole." They wanted full employment. The cause of unemployment was the shrinking world market for British coal, textiles, ands teel. The Labor party, however, believed full employment could be attained by government ownership of basic industries. The unions called a general strike in 1926 to force through their demands. Civilian volunteers carried on essential work and the strike was quickly ended except for the coal miners, the most distressed of all British workers.

Universal adult suffrage was achieved in 1928, when women were given the same voting rights as men.

The regular election of 1929 favored the Labor party, and MacDonald formed his second Labor cabinet. He had been in office a few months when the great world depression dislocated international trade

and currencies and plunged Britain into a financial crisis The number of unemployed mounted to nearly 3 million The leaders of the three parties then formed an emergency coalition cabinet called the National government MacDonald retained the premiership, but he now owed his support chiefly to the Conservatives The Labor party had "read him out" (expelled him) when his government introduced drastic economies to balance the budget He resigned in 1935 and Baldwin again became prime minister

Three Kings in One Year

George V died in January 1936 and his eldest son, Edward, the popular prince of Wales, came to the throne as Edward VIII Before his coronation the king announced his intention of marrying an American, Mrs Wallis Warfield Simpson as soon as her second divorce became absolute Parliament and the dominions' governments disapproved Edward abdicated on Dec 11, 1936, and his brother the duke of York, was proclaimed king as George VI (*See also* Edward VIII, George VI)

Britain Abandons Free Trade

Since the repeal of the Corn Laws in 1846 Britain had been practically a free-trade country Almost all other nations—even the British dominions and colonies—had put up tariffs that handicapped British exporters When the world depression caused a slump in trade, the dominions asked Britain to import more raw materials from them In return they would favor British manufactures In 1932 Parliament passed the Import Duties Act, comparable in importance with the famous Corn Law repeal The act imposed a basic tariff of 10 per cent on all goods not specifically exempted This paved the way for the Ottawa imperial conference in the same year which worked out "preferential" tariffs within the empire

The Statute of Westminster (1931) had recognized the complete control by the dominions of their foreign as well as domestic affairs The Ottawa conference strengthened the ties of the Commonwealth by binding the members into a closer economic union This, however, did not check the growing nationalism in India and other Asiatic dependencies (*See also* British Commonwealth)

Britain in the Second World War

In 1933 Adolph Hitler came to power in Germany and soon began to rearm the country Great Britain, absorbed in domestic troubles was unprepared for war Hitler seized Austria in March 1938 then made demands on Czechoslovakia Britain, along with France adopted a policy of "appeasement," hoping Hitler's demands could be satisfied short of war Neville Chamberlain, who had become prime minister in 1937, believed he had achieved "peace in our time" when Hitler cynically pledged at Munich (Sept 30 1938) that he had "no further territorial claims in Europe" Six months later Hitler broke the pact and took over most of Czechoslovakia (*See also* Chamberlain, Neville, Czechoslovakia)

Hoping to save Poland from a similar fate, Britain joined with France in guaranteeing Poland s independence Hitler took no action until after Russia signed a peace pact with Germany (Aug 24, 1939) Eight days later (September 1) his army marched into Poland Britain and France declared war two days later Within a week all the members of the British Commonwealth (except Eire) also declared war

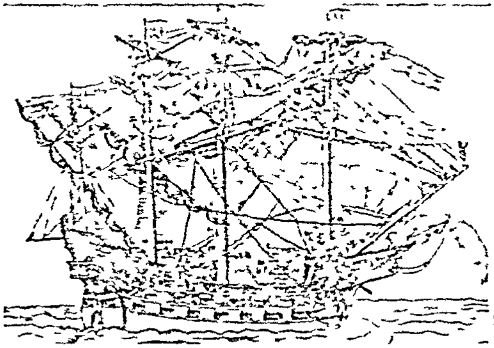
On May 10 1940, Germany invaded Belgium and the Netherlands On the same day Winston Churchill succeeded Chamberlain as prime minister (*see* Churchill) Britain lost most of its armament in the famed retreat from the Dunkirk beaches (*see* Dunkirk) When France fell in June the British began their year alone' and suffered the furious onslaught of German bombers "Let us therefore brace ourselves to our duty" said Churchill, "and so bear ourselves that if the British Commonwealth and Empire last for a thousand years, men will say, 'This was their finest hour'"

The battle of Britain was a victory that ranked in importance with the defeat of the Spanish Armada Britain was saved from invasion by its navy and by its air force small in size but supreme in quality

WHEN BOMBS FELL ON LONDON

During the second World War people all over rural Britain opened their homes to city children Here we see a group leaving London for Cornwall About 120 000 children were evacuated from Greater London in 1940

THERE IS ALWAYS AN 'ARK ROYAL'



The 'Ark Royal' above was the flagship of Admiral Lord Howard, commander of the English fleet that defeated the Spanish Armada in 1588 The ship carried 55 guns and was of 800 tons At the right is its namesake, a 36,000-ton modern aircraft carrier, completed in 1952. Here we see it passing down the slipway after the launching ceremony at Birkenhead.

"Never before in the field of human conflict," said Churchill, "has so much been owed by so many to so few." (For British military and naval action in the war, *see* World War, Second.)

Six years of war cost the British 755 000 combat casualties and about 147,000 civilian casualties. More than 3 million properties were damaged or destroyed—about half of them in London. The war was fought without counting the cost. The United States gave Lend-Lease aid after 1941, but Britain met most of the huge expenditures itself by selling overseas investments, by large overseas borrowing, by domestic loans, and by a tremendous increase in taxation. Income taxes on the rich ran as high as 97 per cent. People with incomes as low as $500 a year paid 45 per cent.

Britain's Socialist Revolution

In 1945 Britain held its first general election in ten years. The Labor party received an overwhelming majority, and Clement Attlee, its leader, succeeded Churchill as prime minister. The party was elected on a socialist platform; and it at once embarked on a program that carried Britain farther on the road to socialism than any other nation of western Europe. The state bought out shareholders in the Bank of England, the coal mines, all inland transport, aviation, gas, and electricity. It subsidized housing and food. It put through the "cradle-to-grave" social insurance plan drawn up under Churchill's ministry. It also set up a National Health Service to provide free medical care for all.

The government soon found itself in grave financial difficulties. The country was living beyond its means. Huge loans and grants from the United States and Canada were quickly used up to pay for necessary food and raw materials. The government scaled down imports to bare necessities and ruled that almost the entire output of factories must be sold abroad instead of in the home market. It fixed prices, rationed scarce goods, limited wages, and called on the people to practice "austerity."

To offset the loss of income from foreign investments, Britain needed to double its exports above the prewar level. In 1949 the postwar "sellers'" market ended and the high prices of British products caused a *swift drop in exports*. Britain's reserve in gold and dollars melted away. Faced with bankruptcy, the government scaled down the value of the British pound from $4.03 to $2.80. This made it possible for British manufacturers to sell their goods cheaper in dollar markets. However, it also increased the price of necessary imports from dollar countries and produced further austerity. Financial aid from the United States helped the government to meet its recurring financial crises.

Decline in World Power

The years 1947–49 saw momentous changes within the British Commonwealth and Empire. India, Pakistan, and Ceylon became self-governing nations within the Commonwealth, and Burma was given complete independence. In China, the Middle East, and Egypt, British influence waned. Eire (southern Ireland) cut all ties with Britain and took the name of the Republic of Ireland (*see* British Commonwealth).

On the continent of Europe, Britain no longer held its historic *balance of power*. For centuries it had held to the policy of aiding the weaker country whenever a strong nation threatened to dominate the continent. The second World War gave Russia control of all eastern Europe and created a vacuum of power in the west. Britain had doubts about the proposed European Union, and in the sessions of the Council of Europe its representatives tended to vote against

those urging European federation The British gov ernment gave wholehearted support however to the activities of the North Atlantic Treaty Organization formed in 1949 to meet the threat of Russ an aggression At the cost of increased austerity Brita n greatly expanded its armament production British land sea and air forces shared i i the action taken by the Un ted Nations in defense of South Korea

Winston Churchill Returns to Office

The general election of 1951 returned the Conservat ves to power with Winston Churchill 76 years old as prime minister There l e before us hard times sa d Churchill I have seen worse and had to face worse I do not doubt that we shall come through because we shall use not only party forces l ut we shall use the growing sense of the need to put Brita n back in her place—a need wh ch burns in the hearts of men far beyond these shores '

A revolution in air transport took place in May 1952 when Britain s commercial jet airl ner—a 36 seater De Havilland Comet—began to make regular weekly round trips from London Englan l to Johan nesburg Union of South Africa In about 32 flying hours the Comet traveled a quarter of the way around the world and back

George VI d ed Feb 6 1952 and his elder daughter succeeded h m as Elizabeth II On June 2 1953 she was crowned at Westminster Abbey

L ttle by little the Conservatives lifted restric t ons and controls imposed by the Socialist govern ment Acts denationaliz ng iron and steel and trucking were passed in 1953 Food rationing was ended in 1954 *(See also* Elizabeth II Brit sh Commonwealth and Emp re Great Britain England Scotland Wales Ireland Ireland Northern For Reference-Outline and B bl ography *see* Great Britain)

ENGLISH LANGUAGE There is an old saying in Europe that Italian is the language to use when you want to sing French when you want to make love and English when you want to transact business This is only a popular saying of course and not more than half true but it does show that d ffer ent languages have different characters just as dif ferent people have and that each one has a different sound to the m nd

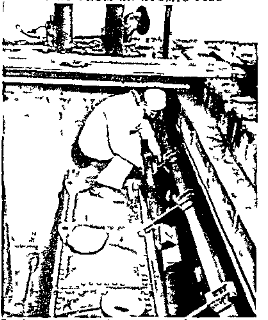
It is true enough that Engl sh is a good language in which to do bus ness for probably—taking into account Great Britain its colonies and the United States—the greater part of the world s commerce is conducted in English But English is good for many other uses besides bus ness Indeed it is one of the richest languages spoken today with more var ety and flexib lity than almost any other and it is used over a greater part of the earth s surface

Growth of the Engl sh Language

English is made up like the people that developed it of many nat onal inheritances and foreign importations and its h story and growth make a very interesting study

Have you ever dug a hole beside a stream and seen the different layers you find as you dig—sand and

HEAT FROM AN ATOMIC PILE



Bri sh scient sts p oneered in setting up the first atomic space-heating system Th s p cture shows an early stage in the construction The p ant hea s offices in several bui dings of the Atomic Research Establ shment at Harwell in Berkshire

gravel and small stones one above the other? If you study the Engl sh language you will find that it was formed in much the same way

Of course when you are speaking you do not notice these layers at all The words are all mixed together, so that often in a single sentence you will say words that come from all the different layers If you say for instance My mother rece ved a good telegram you have used words from four different sources Mother is a very old word and comes from the orig nal Indo-European root language received is a word of Lat n origin good is a Teutonic or Anglo-Saxon word and telegram is from the Greek

Teutonic and Latin Origins

English is classified by philologists or scientists who study words as a Teuton c or Germanic language This is not because more of our words are Teutonic —as a matter of fact not more than one fourth of the words in the dictionary are Teuton c—but because the Teutonic words are the framework of the language the connecting words and the simple fundamental names of ordinary things So that in spite of the fact that only one fourth of our words are Teutonic in the dictionary in ordinary speech about four fifths of the words we use are Teutonic Another reason is that we put our words together with the grammatical construction of the Teutonic languages

After the Teuton c words the most important are words of Latin origin which have come to us either

from the Latin direct, or through the French or Italian or Spanish, but especially French. These words have a different feeling from the Teutonic words when you know them. They are more polished, more stylish you might say, more precise. At one time the Normans, who spoke French, came over and conquered England and ruled over the Teutonic people, the Anglo-Saxons, who lived there. So it came about that the words the common people used stayed Anglo-Saxon or Teutonic and the words of the wealthy and ruling classes became French. For instance as long as a sheep was alive and was tended by the shepherds, who were common people, it was called by the Teutonic word "sheep," but as soon as it was cooked and came on the table of the noble classes, it became "mutton," a French word. In the same way "cow" is Anglo-Saxon and "beef" is French; "hog" is Anglo-Saxon and "pork" is from the language of the conquerors. The influence of the church, the classical Renaissance of the 16th century, and the later coining of scientific terms from the Latin, greatly increased this element in English.

One great advantage which English has over many other languages is the ease with which it forms new words out of old by simply joining them together, as in "rainfall," "railway," "backslide," outcome," "daisy" (from "day's eye"). It is also rich in prefixes and suffixes which can be added to existing words to modify their meaning. Thus we form nouns by the use of such suffixes as *-ness*, *-dom*, *-age*, *-tion*, *-ment*, *-or*, *-ess*, giving us such words as "wickedness," "kingdom," "porterage," "accusation," "amazement," "actor," "prioress." The suffixes *-al*, *-ic*, *-ous*, *-able*, *-ful*, *-ly*, etc., are used to form adjectives, as "critical," "pedantic," "famous," "approachable," "tuneful," "lovely." The prefixes *anti-*, *pro-*, *re-*, *inter-*, *un-*, and a host of others enable us to make such useful words as "anti-slavery," "pro-labor," "reclassify," "interurban," "unnecessary."

The Force in Our Mother Tongue

In general the words of Latin origin are not as strong or as full of meaning as the Teutonic words. For instance the Anglo-Saxon "friendship" has its Latin equivalent "amity," which means just the same thing, but it is a pale word and not nearly so good for most purposes. In poetry, where the color of words is very important, Anglo-Saxon words are usually better than Latin words. But the Latin words have the advantage of being more exact and scientific and for certain purposes are better.

The Greek words are much fewer in number and are largely scientific words, like "geology." We have a number of Dutch words, particularly about the sea, like "schooner"; Scandinavian words (mostly from the old Danish conquest), like "earl," "take," "window"; a few Indian words, like "tomahawk"; some Hebrew words, like "hallelujah"; a good many from the Arabic, like "alcohol"; and an assortment of odd words from almost every other language. We have, too, a few words made up out of whole cloth to describe new things, like "gas" and "kodak," and others, like "buzz," "splash," "chick," are imitations of the sound of things. Some words, too, are names of people, like "sandwich," which came from the Earl of Sandwich, who was too busy gambling to eat regular meals and invented the quick lunch we call by his name; and "boycott," named after an Irish land agent who was its first victim.

Anglo-Saxon the Basis of English

The language of the old Britons was Celtic and survives in modern Welsh, which is still the tongue of Wales. When the Romans conquered England they introduced a certain number of Latin words in the three centuries that they ruled the island. But when the Anglo-Saxons came over from the north of Europe they brought their own Teutonic language with them, which is the basis of English, and there was very little admixture of Celtic and Latin from the conquered inhabitants. The earliest written examples of this Anglo-Saxon are from the 7th century.

The periods in the development of the English language are called Old English (or Anglo-Saxon), Middle English, and modern English. Old English was spoken from about 449 A.D. to 1100, and was very highly inflected—that is, it had a complicated system of grammatical changes to indicate case, number, person, tense, and the like. Middle English was spoken from about 1100 to about 1450, and was much less highly inflected; and modern English, which has developed since 1450, has lost its inflections almost entirely. English speech supplanted French in Parliament and in the law courts of England in 1362.

There have always been, and are today in fact, though now they are only dialects, three varieties of English spoken in England—Northern, Southern, and Midland English. Northern English was important in the very early days and later developed into the Scotch dialect, such as you find in Robert Burns's poems. Southern English was the most important in the Old English period, especially under King Alfred. Modern English developed out of Midland English, in the Middle English period, which stood about halfway between the two. The poet Chaucer, who wrote in Midland English, and the King James Version of the Bible and the English Book of Common Prayer did much to set modern English in the form it now has. Since about 1450 the written language in most important respects has been much as it is today. But the spoken language often differs considerably from the literary tongue, and every age and region has its own dialect, or slang expressions (*see* Slang).

How many words are there in the English language? In the ordinary unabridged dictionary you will find from 300,000 to 500,000, but of course no one person ever uses all of these. It has been calculated that Shakespeare, who had a very wide vocabulary, used not more than 24,000 words in his writings, and 5,000 of those he used only once. Milton uses 17,000 words, and the English Bible only 7,200. In ordinary life few persons use more than 2,000 or 3,000 words. The Greek poet Homer paints all his marvelous pictures of battle and adventure by land and sea with about 9,000 words. (*See also* Language and Literature).

The Rich HERITAGE *of* ENGLISH LITERATURE

ENGLISH LITERATURE The story of England is told in its magnificent literature as well as in its proud history English history has recorded the development of the nation, but only English literature *can tell of the mind and of the spirit behind the* events Pride in England and in its accomplishments threads through the whole course of the literature

The literature of other English-speaking nations, such as the United States and Canada, began with English literature, and its influence remains strong English authors rank with native writers, and most readers make little distinction between them

Old English Literature

ENGLISH literature began in the 7th or 8th century A D The Romans had withdrawn their troops from Britain in A D 410, and the native Britons were left to fight alone against the invasions of the barbarous Picts and Scots from the north In their defenselessness the Britons had called upon the 'friendly tribes' from the European continent the Angles, the Saxons, and the Jutes They came across to help, but after that they seized the Britons' lands in payment for their services By the middle of the 6th century they had pushed the Britons to the western borders of England Then they set up a group of small tribal governments (*see* English History)

With this established society, their literature began From memories of old tribal stories and ceremonies and from tales about the heroic deeds of their ancestors emerged one of the first pieces of English literature, the old Anglo-Saxon or Old English epic, called 'Beowulf', by an unknown author (or authors).

'Beowulf'—Great Anglo-Saxon Epic

Although 'Beowulf' (about 725) is "English" literature, few people can read it now except in translation The Old English language differed greatly from modern English It was a highly inflected language, that is, it had many case endings for the nouns pronouns, and adjectives and a complex system of verbs It resembled modern German in grammar and in much of its vocabulary. Old English was not a very graceful language, but it had a rude strength well suited to the courageous, hardy, and somewhat savage people who spoke it

The story of 'Beowulf' takes place in lands other than England, but the customs and manners described were *those of the Anglo-Saxon people* 'Beowulf' is an epic poem, describing their heroic past It tells of princely Beowulf's three fierce fights—with the monster Grendel, with the equally ferocious mother of Grendel, and with the fiery dragon By conquering them Beowulf saves his people from terrible destruction The verse of 'Beowulf' is characteristic of all Old English verse *It is highly stressed, with the* strong beat falling upon syllables which alliterate (that is, which repeat the same sound) These lines from 'Beowulf' illustrate this forceful technique

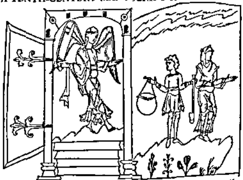
> Lonely and waste is the land they inhabit,
> Wolf-cliffs wild and windy headlands

Much of Old English poetry such as 'The Battle of Brunanburg' and The Battle of Maldon' was heroic and martial The Wanderer and The Sea-Farer' have a sad and pleasing lyric quality These have been called the most beautiful short poems of Old English literature " The first is a poem of weary exile The second has fine lines on the sea, which the poet says

> cries in my ears and calls to my heart
> To launch where the whales plough their path
> through the deep

Only two of the Old English poets are known to us by name Caedmon (7th century) was an unlearned cowherd He was inspired by a vision and miraculously acquired the gift of poetic song Unfortunately, only nine lines of this first known poet survive The second was Cynewulf (8th century) Little is known about him except that he signed his poems in a kind of cypher, or anagram, made up of ancient figures called *runes* (an alphabet used by early Germanic tribes preceding the use of the Roman alphabet in England) His *poems*, such as 'Crist', deal with religious subjects

A TENTH-CENTURY MANUSCRIPT ILLUSTRATION



Old manuscripts were decorated with such pictures as this one showing Adam and Eve being expelled from Paradise (From Garnett and Gosse, 'English Literature', Macmillan.)

The Venerable Bede (673? 735) was the "father of English learning" He was the greatest of all Anglo-Saxon scholars, and his 'Ecclesiastical History of the English Nation' is a storehouse of information, beautifully written One passage is always worth reading his simile about human life

> The present life of man O King *seems to me in comparison* of that time which is unknown to us like to the swift flight of a sparrow through the room wherein you sit at supper in winter with your commanders and retainers and a good fire in the midst whilst the storms of rain and snow prevail abroad the sparrow I say flying in at one door and immediately out at another, whilst he is within is safe from the wintry storm but after a short space of fair weather he immediately vanishes out of your sight into the dark winter from which he had emerged So this life of man appears for a short space but of what went before or what is to follow, we are utterly ignorant

When the Danes invaded northern England in the 9th century the cultural center of England shifted to

the south. This was the land of the West-Saxons. Here the ancient culture was preserved and fostered by the enlightened King Alfred (848?–899). Alfred personally translated five Latin books into the tongue of the West-Saxons, and he ordered a history-diary to be kept of the chief events of each year. This document, known as the 'Anglo-Saxon Chronicle', is of prime importance to historians. Alfred also translated from the Latin Bede's 'Ecclesiastical History', so that his people could study their past. (*See also* Alfred the Great.)

Middle English Literature

IN 1066 William the Conqueror defeated Harold, King of the Anglo-Saxons, at the battle of Hastings. The Norman conquest radically changed English life, and Norman manners and customs prevailed in court and among the aristocracy. The Old English language went untaught and was spoken only by "unlettered" people. The language of the nobility and of the law courts was Norman French; the language of the scholars was Latin. This lasted for nearly three hundred years. During this period the Old English language changed. Its old case endings broke down. The grammar became quite simple. Lost Anglo-Saxon words were more than made up by the addition of French words. The strong, crude iron of the Old English language was being slowly shaped into the flexible steel of present-day English.

The Norman Conquest made just as great changes in the daily lives of people. The loosely organized tribes of the Anglo-Saxons became fused into a single nation, governed by one strong king. Norman architecture and arts brought a new grace and beauty to buildings, statues, paintings, and clothing. Christianity deepened and spread. Manners and morals became more civilized. A new respect for women appeared in the veneration of the Virgin Mary, to whom cathedrals were erected. The whole cult of chivalry came into being, fed by the great Crusades to the Holy Land. The tales of Arthur and his Round Table were one result of this movement. Education flourished. The first universities, Oxford and Cambridge, were founded in the 12th century.

During these three hundred years there was little literature in what became the English language. One or two lyrics ('Sumer is icumen in', 'Alysoun', 1300?) and one or two other works ('Ormulum', 1200? and Layamon's 'Brut', 1205?) have a small interest.

Chaucer Heralds a New Literature

Not until the 14th century did literature in English burst forth in fine variety and excellence. By this time the language, in its altered form called Middle English, had begun to be used by kings and nobles as well as by commoners.

In 1362 it was ordered that English should be the language of law-court pleadings, and by 1385 it was widely taught instead of French. Most of the great literature of the time was written in the 40 years from 1360 to 1400, and a good part of it by one man, Geoffrey Chaucer.

Chaucer (1340?–1400) is one of the world's greatest storytellers. He lived an active life as ambassador for his country and also held many other important offices, such as clerk of the king's works. Chaucer's wide range of experience, meeting all kinds of people, gave him his understanding and tolerance of human behavior. The 'Canterbury Tales' is a masterpiece, with characters who remain eternally alive: the Wife of Bath and her memory of five husbands; the noble Knight returned from heroic deeds; his gay young son, the Squire ("He was as fressh as is the month of May"); the delightful Prioress ("At mete (meat) well ytaught was she with alle/ She let no morsel from her lippes falle."); and the entertaining scoundrels such as the Friar, the Summoner, and the Pardoner. This is a gallery of portraits such as few men have created since. (*See also* Chaucer.)

Chaucer's Contemporaries

At the same time as Chaucer, another man was writing in the northern part of England. He is known as the Pearl Poet, from the name of one of his four poems in an old manuscript. But for general readers, he is better remembered for his narrative poem 'Sir Gawain and the Green Knight'. There were a number of poems about Sir Gawain (just as there were about Sir Lancelot, Sir Perceval, and King Arthur) but this is the best. Unfortunately, it is told in the Lancashire dialect and is almost as difficult to read as Old English. Chaucer's English may be read with a little study since the Midland dialect in which he wrote became the standard one for English writing. But even in translation from its difficult dialect 'Sir Gawain and the Green Knight' is fascinating.

Another poet contemporary with Chaucer was William Langland, a figure almost as shadowy and unknown as the Pearl Poet. His masterpiece, also in a somewhat difficult dialect, was 'The Vision of William concerning Piers the Plowman'. It consists of a series of dream-visions in which human life passes in review. Langland wrote with power and intense sincerity. He attacked the social ills of his time, rebuked evildoers, and urged men to "learn to love."

For nearly 200 years after the death of Chaucer there were almost no great literary men or works produced in England. One noteworthy exception is Sir Thomas Malory (died 1470?). 'Morte d'Arthur' (1485) is his great collection of stories about King Arthur and his knights of the Round Table. Malory made up his book from the many Arthurian stories circulating in French plus the English romances about the knights. 'Morte d'Arthur' has remained the main source book for all the later retellings of the stories. (*See also* Arthur, King; Round Table.)

One of the most important figures in 15th-century literature was not primarily a writer but a printer. William Caxton won lasting fame by setting up the first English press at Westminster, London, in 1476. He published about 80 books, among them 'Canterbury Tales', and 'Morte d'Arthur'. Caxton wrote prefaces to the works he published, and he translated more than 25 books into English. He was

immensely important in creating a wide reading public for his time and in directing its tastes

The other outstanding literary achievement of the times was the creation of the great English and Scottish ballads These were probably sung by people at social gatherings The ballads preserved the local events and beliefs and characters in an easily remembered form It was not until several hundred years later that people began to collect these ballads in books They are immensely vivid stories and modern readers find them especially attractive 'The Wife of Usher s Well' and her three ghost sons, 'Sir Patrick Spens' and his death by drowning, 'Edward' and his murderous revenge are three familiar ballads

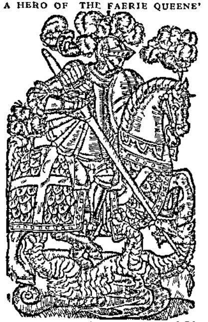
From the Renaissance to the 17th Century

DURING the 15th century, an intellectual movement called the Renaissance appeared in western Europe Renaissance means "rebirth' and refers especially to the revival of ancient Greek learning For several centuries scholars in Italy, Spain, and elsewhere had been translating the ancient works into Latin Printing invented about 1450 provided the means for spreading the books widely This spread of ancient learning kindled a new spirit of inquiry and hastened the overthrow of feudal institutions and ways of thought

Several important discoveries and developments mark the centuries of the Renaissance Columbus discovered America and others sailed around the earth Europeans established settlements in faraway lands and opened trade relations with others Invention of the telescope brought new understanding of astronomy Copernicus (and following him, Kepler) established the conviction that the earth moves around the sun, rather than being the center of the universe Another source of intellectual ferment was the Reformation The revolt against the authority of the Roman Catholic church, led by men like Martin Luther, John Calvin, and John Knox, started inquiry into many matters which had been accepted without question The arts responded to the excitement, and many great writers, as well as painters sculptors, and architects, began making their contributions all over Europe

After its beginnings in Italy and France the Renaissance came to England during the 16th century In England the Renaissance coincides with the reign of the Tudor rulers, Henry VIII, and after the brief monarchies of Edward VI and Mary Tudor, Queen Elizabeth I Under Elizabeth's supremely brilliant rule England became a world power The defeat of the Spanish Armada in 1588 opened the seas of the world to England and roused the nation to a fever pitch of pride Wealth from seagoing commerce poured in to enrich England

A HERO OF THE FAERIE QUEENE'



The Red Cross Knight is the hero of Book I in Spenser s The Faerie Queene This drawing appeared in the 1598 ed tion of the book (Garnett and Gosse, 'English Literature , Macmillan)

English Renaissance Authors

THE THREE great poetic geniuses of Elizabethan times were Christopher Marlowe, Edmund Spenser and William Shakespeare All were characteristic Renaissance men, trained in classic literature fond of fine living full of zest for ideas—men of restless energy Their poetry rings with the gorgeous imagery of the whole Renaissance world

Writing was a social fashion of this time an occupation enjoyed by the nobles as well as by men of lower stations Henry Howard Earl of Surrey (1518?–47) and Sir Thomas Wyatt (1503–42) are two striking instances of this talent for poetry existing in men of affairs Both men were active in England s service and yet in their short lives these two young men became familiar with French and Italian verse forms They adapted the Italian sonnet for English use, and Surrey introduced the use of blank verse in his translation of the 'Aeneid'

A third nobleman with a talent for writing was Sir Philip Sidney (1554–86) He wrote a beautiful sonnet series called 'Astrophel and Stella' (1591), and produced a tremendously long and somewhat tedious, novel called 'Arcadia' (1590) These men wrote only for fun, but they were patrons of the arts in that they gave money and encouragement to poor struggling writers They were also a critical audience for professional writers like Shakespeare and Spenser

Spenser and Marlowe

Edmund Spenser (1552?–99), also active in public service was much more the professional man of letters than Wyatt or Sidney He first came to attention with his 'The Shepheards Calender' (1579), made up of 12 poems one for each month of the year These were poems more skillful and charming than any England had seen for 200 years Spenser wrote many other short poems, including a sonnet series, 'Amoretti', but his masterpiece was 'The Faerie Queene' (1589–96)

'The Faerie Queene' was left unfinished, but the six books written, out of the twelve planned, are of great length. 'The Faerie Queene' is an elaborate allegory built on the story of a 12-day feast honoring the Queen of Fairyland (that is, Elizabeth I of England). Each day of the feast a stranger would appear to ask for help against some knight, dragon, or tyrant, and a knight would be assigned to remedy this distress. Each knight stood for a virtue, and the purpose of the whole work was "to fashion a gentleman or noble person in virtuous and gentle discipline." Book I, in which the Red Cross Knight rescues the fair Una from the wicked dragon in the Woods of Error, is a good illustration of the other books. Spenser worked out a poetic stanza well adapted to tell a story, a special form now known as the "Spenserian stanza." (*See also* Spenser.)

Christopher Marlowe (1564–93) promised more greatness than he achieved. He died at 29, stabbed in a tavern brawl. A line from his own 'Doctor Faustus' is his best epitaph: "Cut is the branch that might have grown full straight." His plays, such as 'Tamburlaine' (1587?) or 'Doctor Faustus' (1588?), brought passion and tragic power onto the stage in lines of great force.

Shakespeare—Genius of Drama and Poetry

The great genius of the Elizabethan age was William Shakespeare (1564–1616). He wrote more than 36 plays, a sonnet group of 154 sonnets, and two narrative poems ('The Rape of Lucrece', 1594, and 'Venus and Adonis', 1593).

BRUTUS SEES CAESAR'S GHOST

In Shakespeare's 'Julius Caesar' the ghost of the murdered Caesar confronts Brutus, one of the men who stabbed him. This engraving is from a painting by Richard Westall.

Like Chaucer, Shakespeare had a genius for telling a story. Though he generally took over stories already told by others, his adaptations of these narratives made them into something new and wonderful. Shakespeare surpassed even Chaucer in creating character. The noble and disturbed Hamlet, pathetic Ophelia, wise Portia, ambitious Macbeth, witty Rosalind, villainous Iago, dainty Ariel—these are a few of the beings Shakespeare made immortal.

Besides his ability to tell a story and to create a character, Shakespeare used words more brilliantly than any other man who ever lived. Phrases and whole lines from Shakespeare have become part of daily speech, such as "the milk of human kindness" or "the play's the thing." And whole speeches are familiar friends, from "To be or not to be" in 'Hamlet' or "All the world's a stage" in 'As You Like It' to "The quality of mercy is not strained" from 'Merchant of Venice'. No one in all history has had a greater command of the right word, the unforgettable phrase, or the sentence striking straight to the heart of truth. (*See also* Shakespeare.)

Contemporary with Shakespeare was Ben Jonson (1573?–1637). Many people once thought him to be a greater playwright than Shakespeare because his plays ('The Alchemist', 'Every Man in His Humor') were more "correct"—that is, they were more carefully patterned after the drama pattern of the ancient Greek and Roman writers. It was not until about a century later that critics began to prefer the deeper genius of Shakespeare and to realize that mechanical "correctness" is not the highest aim of a play or poem. Ben Jonson himself regretted that his friend Shakespeare had "small Latine and less Greeke," but at the same time he generously proclaimed that Shakespeare was the "wonder of our stage" and that "he was not of an age, but for all time!" Ben Jonson's own comedy of 'Volpone' (1606?) is a comical and sarcastic portrait of a wealthy but selfish old man who keeps his greedy would-be heirs hanging on his wishes, each thinking falsely that *he* will inherit Volpone's wealth.

After the greatest days of Shakespeare and Ben Jonson, the English drama declined in excellence. A taste for melodrama and sensationalism hurt much excellent writing by dramatists like John Webster, Thomas Middleton, or John Ford. The dramatists took such liberties with their subjects and language that the Puritan reformers, in control of the city, in disgust ordered the theaters closed in 1642. They did not open again officially until the Restoration of King Charles II in 1660. Then a new drama made its appearance, one much affected by French dramatic styles and methods.

One of the supreme achievements of the English Renaissance came at its close, in the King James Bible. This was a translation ordered by King James I and made by a group of 47 scholars working in fine coöperation. Published in 1611, it is known as the "Authorized Version." It is rightly regarded as the

most influential book in the history of English civilization There had been translations of the Bible before William Tyndale (1492?–1536) first translated *the New Testament from the Greek* into English Miles Coverdale (1488?–1569) made the first complete translation of the Bible into English using Tyndale s version (1535) There had also been others but the King James version combined homely dignified phrases into a style of great richness and loveliness It has been a model of writing for ten generations of English-speaking people

Changing Mood in the 17th Century

THE 17th century is in some ways much different from the Elizabethan period It was more a period of disintegration and decay The difficulties which brought such fierce political and social struggles as resulted in the Civil War and the government under Cromwell are mirrored in the writing The old unity of Elizabethan life was gone The national pride of Englishmen under Queen Elizabeth I lessened as the Crown lost dignity through the behavior of King James I and the two King Charles s A new middle class began to show its power

The glowing enthusiasm of men like Marlowe and Spenser gave way to the cool scientific attitude to the spirit which studies small details rather than large generalizations and which looks to the world of fact more than to that of the imagination Late in the 16th century Sir Francis Bacon took 'all knowledge for his province," a typical Renaissance ambition Later scientists staked out much smaller and more workable claims Discovery on the grand scale gave way to exploitation of discovery—to colonization and trade activities which helped the mercantile class to wealth and to power late in the century

THE DREAM OF JOHN BUNYAN

This picture appeared as the frontispiece to the fourth edition of Bunyan s The Pilgrim s Progress (Garnett and Gosse English Literature Macmillan)

Prose Writings of the 17th Century

The 17th century was an age of prose Interest in scientific detail and in report and leisurely observation mark the prose writing of the time This new prose style emphasized clarity, directness, and economy of expression It first appears just before 1600 in the Essays' of Sir Francis Bacon (*see* Bacon Francis) The physician Sir Thomas Browne (1605–82) wrote with dry precision in Pseudodoxia Epidemica (1646), as he amusingly and gravely discussed beliefs like That an elephant hath no joints' or "That hares are both male and female ' Robert Burton (1577 1640) in his 'Anatomy of Melancholy' wrote a psychological book which has long remained a source of amusement to readers interested in the eccentric observations of a curious mind Izaak Walton (1593–1683) wrote the great classic of fishing 'The Compleat Angler' (1653)

The prose masterpiece of the century was however, 'The Pilgrim s Progress (1678) John Bunyan (1628–88) had studied the King James version of the Bible, and with it as a style model, he wrote a study of a Christian s journey through life and the difficulties that beset him as he tries to reach the Celestial City The Pilgrim s Progress was for more than 200 years second only to the Bible in popularity Even today it is still much read for its vigorous scenes of English country life (*See also* Bunyan John)

The religious zeal of John Bunyan contrasts with the cavalier spirit of Samuel Pepys (1633–1703) As secretary to the Admiralty Pepys was a career man He loved London and its life and he recorded his daily experiences in shorthand in a diary (published in 1825) It is a splendid book of gossip a record both of the delightfully trivial and of the important events such as the Great Plague (1664–65) the Great Fire (1666) and of the behavior of the court Pepys' Diary' is a window opened *onto the last part of the 17th* century in England

John Milton Puritan Poet

The sober scientific spirit of the 17th century did not destroy poetry The great poet of the earlier half of the century was John Milton (1608–74) a Puritan who served Oliver Cromwell as Latin secretary He first wrote some short poems the best known being L'Allegro' and 'Il Penseroso The first tells the day's activities of a cheerful man, and the second one of the night s activities of a thoughtful scholar A music play or masque known as Comus' was produced in 1634 with music by Henry Lawes before the lord president of Wales Milton's greatest early poem was a lament called 'Lycidas' (1637), for the death of a college friend

Milton s services under Cromwell brought on blindness This did not stop his poetry He dictated his masterpiece 'Paradise Lost' (1667) to his daughters *This is an epic poem telling of the Fall* of the Angels the creation of Adam and Eve, and of their temptation by Satan in the Garden of Eden (Of Man s first disobedience, and the fruit/ Of that forbidden tree ') It is written in blank (unrhymed) verse of great weight and solemnity

'Paradise Regained' (1671) was Milton's sequel to 'Paradise Lost' He thought the later work his masterpiece, but most readers have not agreed with him Milton's last work was a blank verse tragedy

in the ancient Greek manner. It dealt with the Bible story of Samson and Delilah. 'Samson Agonistes' (1671) is in many ways Milton's allegorical description of himself as a Samson bound in chains by his enemies, the followers of King Charles II.

The Cavalier and the Metaphysical Poets

Beside the somewhat forbidding greatness of John Milton, the poetry of other 17th-century men is at times a relief. The Cavalier poets were followers and supporters of King Charles I. They wrote with a sense of elegance and in a style which emphasized wit and charm and the delicate play of words and ideas. Chief among the Cavalier group were Thomas Carew, Richard Lovelace, Sir John Suckling, and Robert Herrick. Herrick (1591–1674) was a clergyman in the Church of England; but his ministerial duties did not prevent him from admiring a pretty face or the loveliness of the English landscape. His poems are among the most tuneful and delightful of the century, dealing with homely and familiar subjects. As he said in 'The Argument of His Book':

> I sing of brooks, of blossoms, birds, and bowers,
> Of April, May, of June, and July flowers;
> I sing of May-poles, hock-carts, wassails, wakes,
> Of bridegrooms, brides, and their bridal-cakes.

And he lists many more subjects. Such poems as 'Corinna's going A-Maying' or 'Upon Julia's Clothes' have long been favorites of readers.

Another important group were the Metaphysical poets. The word "metaphysical" means the use of "conceits"—that is, of far-fetched similes and metaphors intended to startle the reader into understanding a new relationship between things ordinarily not associated. For instance, John Donne (1573–1631), an important preacher as well as poet, in one poem compares the separated lovers to the two feet of a pair of compasses. The Metaphysical poets felt it important to combine ideas and emotion in their poetry. It is the union of thought and feeling which makes their poetry at once quite difficult and at the same time attractive. In recent years the Metaphysical poets have been much studied and imitated by modern English and American poets. George Herbert, Henry Vaughan, and Richard Crashaw wrote intensely complicated religious poetry in this manner. More easily understood, perhaps, is Andrew Marvell (1621–78), at least in the well-loved lyric 'To His Coy Mistress'. It conveys an urgent sense of the fast passage of time, in such lines as:

> But at my back I always hear
> Time's winged chariot hurrying near.

John Dryden (1631–1700) is the important literary figure of the latter half of the century. He was the leading poet. Poems like 'Absalom and Achitophel' (1681–82) and 'Alexander's Feast' (1697) establish his superiority both in satire and lyric. He was also the leading dramatist, writing both comedy ('Marriage à-la-Mode', 1673, and 'The Kind Keeper', 1680) and tragedy ('Aureng-Zebe', 1675) of great popularity. Finally he was the leading critic. His prose, best seen in the prefaces of his plays, has the flexible, modern style to be found in good writing of the 20th century. The king had the good sense to appoint Dryden "poet laureate," an office of more honor than reward since it paid but 100 pounds a year plus a cask of wine. Most of what Dryden wrote, however, is so closely connected with political and social events of his day that to read it requires a scholar's knowledge of the period. The virtues of his best writing—its clarity, good sense, and intellectual vigor—became the dominant virtues of the writing of the 18th century. (*See also* Dryden.)

The 18th Century—An Age of Reason

The political and social conflicts which split England during the 17th century were reconciled in the 18th. The establishment of parliamentary government at last settled the issue of where political power should rest. The "glorious revolution" of 1688 forever finished the old aristocratic theory of "the divine right of kings." The middle class, whose rise began in the 17th century, now came to power. Many of the ideas basic to democracy were born during this century. The idea that power should rest in the people was probably the most important one.

Merchants and tradesmen achieved great economic power. Scientific discoveries were encouraged. Many important inventions, such as Arkwright's spinning frame, Cartwright's power loom, and Watt's steam engine brought an industrial society. Cities grew in size, and London began to assume its present position as a great industrial and commercial center.

In addition to a comfortable life the middle class demanded a respectable, moralistic art controlled by common sense. They reacted in protest to the aristocratic immoralities in much of the Restoration literature. Many people of the time thought that they were passing through a golden period similar to that of the Roman emperor, Augustus. Hence, the name "Augustan" had been given to the early 18th century.

18th-Century Prose Writers

The Modern essay began with *The Tatler* (1709–11) and *The Spectator* (1711–12), two periodicals created by Richard Steele (1672–1729) and Joseph Addison (1672–1719). Their kindly and witty essays appealed to the middle class in the coffeehouses rather than to the nobility in their palaces. The aim of *The Spectator*, Addison said, was ". . . to enliven morality with wit, and to temper wit with morality." Steele's and Addison's essays are still models of clear, informal writing.

Most people think of Daniel Defoe (1661?–1731) only as the author of 'Robinson Crusoe' (1719). But when Defoe wrote that novel he had already lived a life full enough for three ordinary mortals. Defoe was first of all a journalist, with an eye for a news story. Single-handed he produced a newspaper, *The*

Review (1704–13) which is perhaps the ancestor of modern newspapers The list of Defoe s writings run to more than 400 titles In all of them art ks and books is the kind of writing which Defoe recommended to others—a plain and homely style Even the great novels of his last years Moll Flanders (1722) and Robinson Crusoe read like a modern news *reporter s account of events* (*See also* Defoe)

Swift—Scornful Genius in Prose

Jonathan Swift (1667 1745) is one of the great prose writers of all time Although born in Ireland Swift always said that he was an Englishman But Swift s defense of the Irish people against the tyranny of the English government was whole-hearted However Swift may have disliked Ireland he disliked injustice and tyranny more In a bitter pamphlet A Modest Proposal (1729) he ironically suggested that the Irish babies be specially fattened for profitable sale as meat since the English were eating the Irish people anyhow by heavy taxation

Swift s masterpiece is Gulliver s Travels (1726) It s a satire on human folly and stupidity Swift says that he wrote it to vex the world rather than to divert it But most people are so delightfully entertained by the tiny Lilliputians or by the huge Brobdingnagians that they do not bother much with Swift s bitter satire on human littleness or grossness No one has ever written English with greater sharpness and economy than Jonathan Swift His literary style has all the 18th century virtues at their best (*See also* Swift)

Satire in Pope s Poetry

The genius of Alexander Pope (1688–1744) lay in satirical poetry He said that he wanted to shoot folly as it flies /And catch the manners living as they rise The Dunciad (1728) listed the stupid writers and men of England by name as dunces These dunces did not care for such publicity and proceeded to attack Pope

Pope excelled in his ability to coin unforgettable phrases Such lines as Fools rush in where angels fear to tread or Damn with faint praise illustrate why Pope is the most quoted poet in English literature except for Shakespeare

DANIEL DEFOE S ROBINSON CRUSOE

This picture was the frontispiece for the first edition of Defoe's famous novel of a man who struggles for life on a desert island *See* Crusoe

One of his lighter although still satirical poems is The Rape of the Lock (1712 14) which mockingly describes a furious fight between two families when a young man snips off a lock of the beautiful Belinda s hair Alexander Pope wrote in heroic couplets a technique in which he has been unsurpassed In thought and in form he carried 18th century reason and order to its highest peak (*See also* Pope)

Start of the Modern Novel

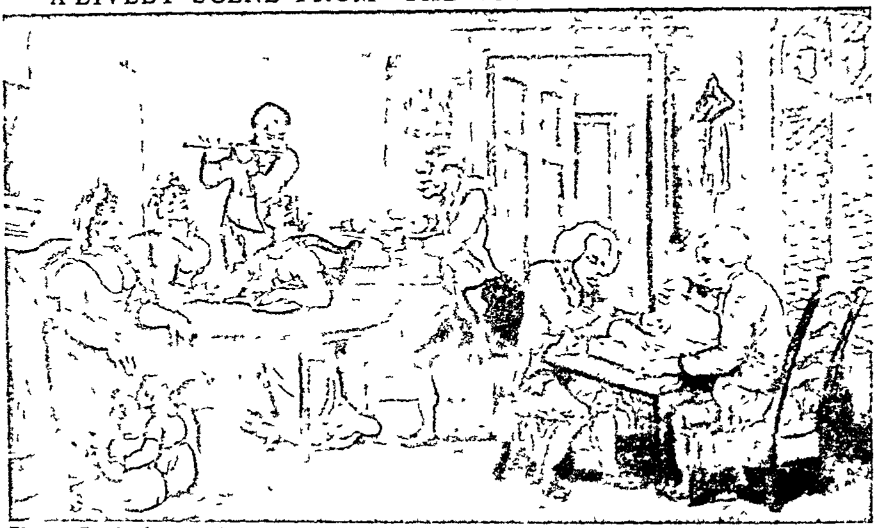
THE 20th century can be grateful to the 18th for developing the novel (*see* Novel) Samuel Richardson (1689–1761) wrote the first modern novel—that is one with a fairly well planned plot with suspense and climax and with some attempt to understand the mind and hearts of the characters This important novel Pamela' (1740) is made up of letters from Pamela Andrews She tells of her unhappy attempts to get a husband but the book ends happily

Henry Fielding (1707 54) was amused by Pamela and tried to parody it in Joseph Andrews (1742) which pretended to be the story of Pamela s brother Seven years later he wrote Tom Jones (1749) in many ways the greatest novel in English literature It tells the story of young Tom Jones the foundling who is driven from his adopted home wanders to London and eventually for all his suffering wins his lady The picture of English life both in the country and in the city is brilliantly drawn The humor of the book is delightful

The first novel of Tobias Smollett (1721 71) was Roderick Random (1748) Although it is a striking collection of adventures it lacks the good plot of Tom Jones Smollett s best work is Humphry Clinker (1771) It tells by means of letters the story of a trip by the Bramble family across England from Bath to London and up into Scotland The eccentric characters have many comic experiences

Laurence Sterne (1713–68) wrote A Sentimental Journey (1768) partly in answer to a travel book written in ill temper by Smollett Sterne s greatest book is Tristram Shandy (1760–67) a topsy turvy collection of episodes with little organization but containing a wealth of 18th-century humor

A LIVELY SCENE FROM 'THE VICAR OF WAKEFIELD'



Thomas Rowlandson, well-known caricaturist and painter of the 18th century, made this illustration for Goldsmith's delightful novel. (From Garnett and Gosse, 'English Literature', Macmillan.)

Dr. Johnson and His Circle

IF THE 18th century made much of elegance and good manners, it also made much of honesty and common sense. These useful virtues were personified by Dr. Samuel Johnson (1709–84), the leading literary figure of the century. He wrote some sensible but uninspired poetry ('The Vanity of Human Wishes', 1749). His novel, 'Rasselas' (1759), is equally sensible and equally dull. His masterpiece was 'A Dictionary of the English Language' (1755). Dr. Johnson's common sense is shown in the clear definitions of words. He made some mistakes, however. One lady asked him why he defined "pastern" as "the knee of a horse." Dr. Johnson answered, "Ignorance, Madam, pure ignorance."

Doctor Johnson is immortal, not for what he wrote, but for his forceful personality and his wonderful conversation. This is recorded by James Boswell (1740–95) in 'The Life of Samuel Johnson, L.L.D.' (1791) This is the greatest of English biographies. Boswell had an eye for significant detail and a proper reverence for his subject. We see all of Dr. Johnson's peculiarities—his rolling walk, his twitching face, his horrible table manners his rudeness to stupid people—but we also see his sturdy common sense and relentless honesty. (*See also* Johnson, Samuel)

Doctor Johnson and others organized a Literary Club in 1764 The club gathered together the most celebrated artists of the time. The great orator, Edmund Burke (1729–97), and the great historian, Edward Gibbon (1737–94), were members. Another member was Oliver Goldsmith (1728–74). He wrote one of the best plays ('She Stoops to Conquer', 1773), one of the best poems ('The Deserted Village', 1770), and one of the best novels ('The Vicar of Wakefield', 1766) of the latter half of the 18th century. Dr. Johnson said of his versatile friend: "[He] touched nothing that he did not adorn." (*See also* Goldsmith.)

Thomas Gray (1716–71) lived a retired life of study and thought. His most famous poem 'Elegy Written in a Country Churchyard' (1751) has been recited more often than any other poem of equal length in the language. The 'Elegy' anticipates Romantic poetry in its sympathy for lowly folk ("the short and simple annals of the poor") and in its pleasing melancholy.

The Romantic Movement in England

AT THE close of the 18th century a new literature arose in England. It was called *Romanticism*, and it opposed most of the ideas that the old 18th century stood for. Romanticism had its roots in a changed attitude toward mankind. The forerunners of Romanticism argued that men were naturally good; society makes them bad. If the social world could be changed all men might be happier. Many reforms were suggested: better treatment of people in prisons and almshouses; fewer death penalties for minor crimes; and increase in charitable institutions.

The Romanticists believed that all men are brothers and deserve the treatment to which human beings are by nature entitled. Every man has a right to life, to liberty, and to equal opportunity. These ideas had been well stated in the American Declaration of Independence. In France the Revolution of the common people began in 1789. Many Englishmen hoped that the new democracies—France and America—would show the way for the rest of the world to follow. Along with democracy and individualism came other ideas One was that the simple, humble life is best. Another was that people should live close to nature.

Romanticism in Literature

BECAUSE of this concern for nature and the simple folk, literature began to take an interest in old legends, folk ballads, antiquities, ruins, "noble savages," and rustic characters. Many writers began to give more play to their senses and to their imagination Their pictures of nature became livelier and more realistic. They loved to describe rural scenes, graveyards, majestic mountains, and roaring waterfalls They also liked to write poems and stories of

such eerie, supernatural things as ghosts, haunted castles, fairies, and mad folk.

Thus Romanticism grew. But the movement cannot be precisely defined. It is a group of ideas, a web of beliefs. No one Romantic writer expressed all these ideas, but he believed enough of them to set him apart from earlier writers. The Romanticist was emotional and imaginative. He acted through inspiration and intuition. He believed in democracy, humanity, and the possibility of achieving a better world.

Pre-Romantic Writers

Before the Romantic movement burst into full expression there were beginners or experimenters. Some of them are great names in English literature. Robert Burns (1759–96), a Scot whose love of nature and freedom has never been surpassed, scorned the false pretensions of wealth and birth—"A man's a man for a' that." His nature lyrics are tenderly beautiful ('To a Mountain Daisy'), his sentimental songs are sung wherever young and old folks gather ('Auld Lang Syne', 'Flow Gently Sweet Afton'). His rich humor can still be felt in 'Tam o'Shanter', 'To a Louse', and 'The Cotter's Saturday Night'. (See also Burns.)

BURNS POET OF THE SCOTTISH COUNTRYSIDE

Here Burns looks at a small boy who may very well have been himself in childhood. This picture is from 'Burns—by Himself', a collection of Burns's autobiographical writings arranged and illustrated by Keith Henderson (Methuen).

William Cowper (1731–1800) cried out against the inhumanity of slavery and political oppression in many places in his long poem, 'The Task'. William Godwin and his wife, Mary Wollstonecraft, were intense social critics. Mary Godwin's vindication of the 'Rights of Women' (1792) was one of the first feminist books in all literature. Godwin's 'Political Justice' (1793) had a great influence on Wordsworth, Coleridge, and Shelley.

James Macpherson (1736–96), another Scotsman, composed an elaborate epic poem which he claimed he had translated from the work of an ancient Scottish bard, Ossian (see Ossian). Thomas Percy (1729–1811) collected old English songs and ballads. His 'Reliques of Ancient English Poetry' (1765) is our best source of the songs of medieval England.

Another group of forerunners of Romanticism includes the writers of stories of terror and imagination—the Gothic school of 'spine chillers'. Among these were Horace Walpole ('The Castle of Otranto'), Ann Radcliffe ('The Mysteries of Udolpho'), and Matthew G. Lewis ('The Monk'). All these novels are filled with the machinery of sensationalism—unreal characters, supernatural events, and overripe imagination. These qualities reached a fever pitch in Mary W. Shelley's 'Frankenstein' (1818).

The First Great Romanticists

William Blake (1757–1827) was both poet and artist (see Blake, William). He not only wrote books but he also illustrated and printed them. Many of his conservative contemporaries thought him insane because his ideas were so different. Chief among these 'insane' ideas was his devotion to freedom and to universal love. He was interested in children and animals—the most innocent of God's creatures. As he wrote in 'Songs of Innocence' (1789):

When the voices of children are heard on the green,
And laughing is heard on the hill,
My heart is at rest within my breast,
And everything else is still.

Certainly no one put more wonder and mystery into beautiful melodic verse than did Samuel Taylor Coleridge (1772–1834). The strange, haunting supernaturalism of 'The Rime of the Ancient Mariner' (1798) and 'Christabel' (1816) has universal and irresistible appeal. (See also Coleridge.)

A close friend of Coleridge for many years was William Wordsworth (1770–1850). Together they brought out a volume of verse, 'Lyrical Ballads' (1798), that sounded the new note in poetry (see Wordsworth). While Coleridge found beauty in the unreal, Wordsworth found it in the realities of nature, where he heard "a thousand blended notes":

One impulse from a vernal wood
May teach you more of man,
Of moral evil and of good,
Than all the sages can.

From nature Wordsworth learned that life may be a continuous development toward goodness ("The child is father of the man"). He believed that if man heeds the lessons of nature he will grow in character and moral worth.

Charles Lamb (1775–1834), a schoolmate of Coleridge, for the most part had little of the serious quality that one sees in the authors of the 'Lyrical Ballads' (see Lamb). Nor was he an ardent lover of nature. A city man, he showed how a person could live happily among his books by his own fireside. His best known essay is the playful 'Dissertation on Roast Pig' (1822). He and his sister Mary rewrote many of Shakespeare's plays into stories for children, 'Tales from Shakespear' (1807).

An interest in the past, a curiosity about all kinds of people, and a love of rugged, picturesque scenery

can be found in the work of Sir Walter Scott (1771–1832). 'The Lay of the Last Minstrel' (1805) and 'The Lady of the Lake' (1810) are most representative of his poems about stirring incidents in the border warfare between England and Scotland.

Between 1814 and 1832 Scott wrote 32 novels, among them 'Ivanhoe' (1819) and 'Guy Mannering' (1815). These set the pattern for all historical fiction since. In his historical novels Scott wrote on a broad scale, dealing with people in all ranks of life, from royalty to serfdom. (*See also* Scott, Sir Walter.)

Among the lesser Romantic figures was Robert Southey (1774–1843), poet laureate of England and author of 'The Three Bears' and 'The Battle of Blenheim'. An industrious writer, he earned his living solely by his pen. William Hazlitt (1778–1830), a friend of the Lake poets, also earned his way by lecturing and by writing for the great critical magazines of the period.

Of this group of Romantics not one was born to wealth or position. Coleridge was the son of a clergyman; Wordsworth had a small inheritance (insufficient to live on). Scott was a lawyer's son. Blake and Lamb were born poor and died poor. Lamb earned his living as a clerk in the offices of the East India Company. Wordsworth held various government positions. Coleridge, when able to work at all, was employed by commercial firms. Scott was a lawyer, and not until he began writing novels was he able to live by his literary efforts. The lot of the man of letters, no matter how famous he may have been, was not easy.

The Younger Romanticists

By 1812 the older Romanticists had become conservatives in politics. They no longer supported radical causes or championed the oppressed. But the younger Romantic writers quickly and somewhat noisily took up the cudgels for liberty and justice.

Lord Byron (1788–1824) was an outspoken critic of the evils of his time. Byron hoped for human perfection, but his recognition of man's faults led him frequently to despair and disillusionment ('Manfred', 'Cain'). Much of his work is satire, bitterly contemptuous of human foibles ('Don Juan'). His narrative poems ('The Corsair', 'Mazeppa'), about wild and impetuous persons, brought him instant success. He was a skilled versifier with a remarkable ear for rhythms. More than any other Romanticist Byron influenced the youth of his day. "Byronism" was a mood copied by thousands of young men and admired by thousands of young women. (*See also* Byron.)

Percy Bysshe Shelley (1792–1822) was the radical black sheep of a well-to-do conservative home. Sonnets, songs, poetical allegories, and poetic dramas flowed from his pen in profusion in the last four years of his life. Many of these works are profound and meditative ('Prometheus Unbound'). Others are exquisitely lyrical and beautiful ('The Cloud', 'To a Skylark', 'Ode to the West Wind'). 'Adonais', his tribute to his friend Keats, ranks among the greatest elegies in English verse. (*See also* Shelley.)

Unlike Byron and Shelley, John Keats (1795–1821) was not born to wealth (*see* Keats). Yet as a poet he is greater than either of his two celebrated contemporaries. Keats believed true happiness was to be found in art and natural beauty ('Ode on a Grecian Urn', 'Ode to a Nightingale'). His verse is lively testimony to the truth of his words in 'Endymion':

> A thing of beauty is a joy forever:
> Its loveliness increases; it will never
> Pass into nothingness;

Many other Romantic writers deserve to be mentioned. There is Leigh Hunt, whose 'Abou Ben Adhem' continues to be a favorite. There is Thomas Moore, Irish friend of Byron, whose 'Believe Me, If All Those Endearing Young Charms' still charms any vocal group. And there is Thomas De Quincey, known best for his 'Confessions of an English Opium Eater'. He ought, however, to be better known for his very useful distinction between the "literature of knowledge" and the "literature of power."

The Literature of the Victorian Age

THE literature written during the reign of Queen Victoria (1837–1901) has been given the tag name "Victorian." The basic characteristics of the period, however, would have been the same with or without Queen Victoria. Many great changes took place in the first half of the 19th century. Intellectual rebellions such as those of Byron and Shelley gave place to balance and adjustment. Individualism began to be replaced by social and governmental restraints. More and more people began to win comfort and prosperity. Britain changed from a provincial nation to an empire, and its power spread over the entire world. This progress brought its own problems. Often men had to choose between ideals and material gain. When personal profit or comfort were involved, principles were many times forgotten.

Science made rapid strides in the 19th century. The theory of evolution gave new insight to the biological sciences. Technical progress transformed Britain into a land of mechanical and industrial activity. But science created doubt as well as materialistic optimism. Old ideas of faith and religion were put to serious tests by the new attitudes created by scientific progress. There was a re-emphasis, oftentimes stuffy and pompous, of moral and religious beliefs. Art, said some, must teach better ways of living. Literature should show people how to be good.

Nevertheless, many people in England were still poor—badly housed, undernourished, and sick. It was obvious that progress would not come by itself. Progress had to be earned. Freedom had to be guarded zealously. Would the spirit of man be destroyed by the machine? Would people become slaves to industry and the pursuit of wealth? Would art be replaced by skill and craft? These were the problems that beset Englishmen in the age of Queen Victoria. At the time

they were lumped into one phrase and called the "condition of England" problem Few writers were able to ignore that problem

Major Victorian Poets

THE RESULT of the "condition of England" problem was a shift from the extreme personal expression (called *subjectivism*) of the Romantic writers to an objective survey of the problems of human life The poetry of Tennyson, Browning and Arnold especially reflect this change Much Victorian poetry was put to the service of society

Alfred Tennyson (1809-92) attempted to give direction to his readers Much of his poetry is deliberately didactic (that is, intended to teach) 'The Princess' is a discussion of women's rights and education 'Idylls of the King' is a disguised study of current ethical and social conditions 'Locksley Hall', 'Maud', and 'In Memoriam' deal with conflicting scientific and social ideas But much of Tennyson s poetry could —and can still—be read without worrying about such problems His narrative skill makes many of his poems interesting just as stories Each of the Arthurian tales in 'Idylls of the King' brings the reader a wealth of beauty and experience The Lady of Shalott and 'Oenone' are pleasing tales to young readers 'Dora' and 'Enoch Arden' may bring easy tears but they still are widely appreciated The character study, 'Ulysses', has unusual appeal to the modern mind because of its emphasis on the strenuous life. *(See also* Tennyson)

For those who have seen Rudolph Besier s play 'The Barretts of Wimpole Street', Elizabeth and Robert Browning need no introduction Elizabeth Barrett (1806–61) wrote the most exquisite love poems of her time (Sonnets from the Portuguese') These sonnets were written secretly while she was being courted by Robert Browning *(see* Browning, Elizabeth, Browning, Robert)

Browning (1812 89) is best remembered for his dramatic monologues—studies in character analysis 'Fra Lippo Lippi', 'Andrea del Sarto', 'My Last Duchess' are excellent examples of this poetic type The stirring rhythms of 'How They Brought the Good News from Ghent to Aix' and the simple wonder of 'The Pied Piper of Hamelin' endear Browning to readers His expressions of personal optimistic faith have been the source of inspiration for thousands of readers (Epilogue to Asolando', 'Rabbi Ben Ezra' 'Prospice') The poetic drama 'Pippa Passes' has long been considered one of his finest efforts

19TH-CENTURY LIFE AS TOLD BY JANE AUSTEN

This picture by H M Brock originally in color, shows one of the delightful social gatherings described in Pride and Prejudice (copyright Macrae Smith Co)

Many think that Pippa s words 'God s in his heaven/All s right with the world," summarize Browning's philosophy It is more probable that his real belief is found in Fra Lippo Lippi s famous statement

This world s no blot for us
Nor blank it means intensely
and means good
To find its meaning is my
meat and drink

The poetry of Matthew Arnold (1822–88) is marked by an intense seriousness and classic restraint Despite this, many of his poems are popular 'Sohrab and Rustum' is a fine blank verse narrative His elegiac poems on the death of his father, Thomas Arnold ('Rugby Chapel), and of his friend Arthur Hugh Clough ('Thyrsis'), are profound and moving His interest in the problem of making Englishmen aware of finer and higher values of life caused him to quit writing poetry and to turn to critical prose As a critic, he drove his ideas home with clarity and force ('Hebraism and Hellenism')

Arnold's somber and disillusioned poem, 'Empedocles on Aetna', was characteristic of the poetry dealing with the conflict between religion and science A much more popular poem on the same theme was Edward Fitzgerald s free translation (1859) of the 'Rubáiyát of Omar Khayyám', originally written by Omar, a Persian astronomer Fitzgerald claimed that the only course of action left to the man whose religious ideals had been destroyed by science was self-indulgence

The Pre Raphaelite Brotherhood

The Pre-Raphaelites, a group of painter poets, rebelled against the sentimental and the commonplace

They wished to revive the artistic standards of the time before the Italian painter Raphael (1483–1520). Their poems are full of mystery and pictorial language. One member was Dante Gabriel Rossetti. His 'The Blessed Damozel' and 'Sister Helen' are typical of their highly sensuous verse. His sister Christina Rossetti's 'Goblin Market' is one of the most fanciful poems in the language. (*See also* Rossetti, Christina; Rossetti, Dante.)

William Morris (1834–96), like the Rossettis, was interested in both painting and poetry. His interest in handicrafts grew into a philosophy of art, and he dedicated the rest of his life to the attempt to bring a love of workmanship back into the English workingman's life. This activity took two forms; the promotion of the crafts through such organizations as the Kelmscott Press and the promotion of the worker's happiness through gild socialism. 'The Earthly Paradise' is a series of tales linked by the same device used in Chaucer's 'Canterbury Tales'. In 'A Dream of John Ball', a prose romance, Morris dealt with one of the leaders of the 14th-century revolt of Wat Tyler. (*See also* Morris, William.)

DICKENS' 'OLIVER TWIST'

This picture for 'Oliver Twist' was drawn by the famous English illustrator, George Cruikshank. Little Oliver stands with bowl and spoon in hand begging for food.

Another poet closely associated with the Pre-Raphaelites and Morris was Algernon Charles Swinburne (1837–1909). Swinburne wrote many verse-dramas on classical and historical subjects. Many of his lyrics were severely criticized for their sensuous eroticism. All his poetry was filled with rich melodic effects. Some critics have said that his verse is all "sound and fury signifying nothing." (*See also* Swinburne.) The direct opposite of Swinburne was Gerard Manley Hopkins (1844–89), a Jesuit priest. His imagery and metrical technique were so modern that they could not be appreciated until recent times. His subject matter was intensely religious.

Victorian Novelists

The English novel came of age in the Victorian period. There had been a decline in novel writing at the beginning of the century, partly because fiction had turned to sensation, horror, and crude emotionalism and partly because of religious and moral objection to the reading of novels. Even Scott at first considered the craft of the novelist degrading and kept his authorship a secret. Jane Austen (1775–1817), one of the most gifted writers of realistic novels, had difficulty finding a publisher for her skillfully drawn portraits of English middle-class people, such as 'Pride and Prejudice' (1813).

CHARLOTTE BRONTE'S 'JANE EYRE'

Here Jane Eyre meets her new and mysterious employer Mr. Rochester, master of Thornfield Hall, as he rides with his dog through the lonely English countryside. This picture is by Fritz Eichenberg (Random House).

Dickens and Thackeray

With the rise of the popular magazine (*Fraser's Magazine*, *Bentley's Miscellany*), authors began to experiment with serialized fiction. Before they knew it they were actually writing novels. Such was the beginning of Dickens ('Sketches by Boz') and of Thackeray ('The Yellowplush Correspondence'). Neither knew he was a "novelist" until he had thus learned that he could combine atmosphere, character, and plot. Charles Dickens (1812–70) became a master of local color—scenes, costumes, dialect. Few of his novels have convincing plots. Accident and coincidence govern the action. But in characterization and in the creation of moods he is unequaled. By 1850 Dickens had become England's best-loved novelist. (*See also* Dickens.)

The talents of William Makepeace Thackeray (1811–63) produced a different type of novel. He was not a reformer like Dickens, and he was not moved to tearful sentiments by the world's unfortunates. Instead, he attempted to see the whole of life—detached and critically. He disliked sham, pretense, hypocrisy, stupidity, false optimism, and self-seeking. The result was satire—a comedy of manners. Literature would be the poorer without 'Vanity Fair' (1847) and its heroine Becky Sharp. (*See also* Thackeray.)

Other Victorian Novelists

The Brontë sisters (Charlotte, 1816–55; Emily, 1818–48; Anne, 1820–49) wrote strange, tortured novels as an escape from their own drab lives. Charlotte's 'Jane Eyre' is wildly

melodramatic, as is also Emily's 'Wuthering Heights' But the latter is redeemed by its ventures beyond reality into the strange world of mad genius

From the Topsylike novels of Dickens and Thackeray that "just growed," English novelists turned to the logical plot and the concept of a central theme Anthony Trollope (1815–82) dealt with commonplace, middle- and upper-class people interestingly, naturally, and wittily George Eliot (1819–80) was one of England's greatest women writers In such novels as 'Silas Marner' (1861) and 'Middlemarch' (1871–72), she used the novel as a means of interpreting life She considered herself a "moral scientist" Wilkie Collins (1824–89) was one of the earliest novelists to build a novel wholly around an ingenious plot—the formula that is used in the modern mystery story 'The Moonstone' (1868) is his best work

STEVENSON S THE BLACK ARROW'

'The Black Arrow is a thrilling story based on the Wars of the Roses Here opposing forces of the houses of York and Lancaster battle in the snow The picture, originally in color, is by N C Wyeth (Scribner s)

As biological and psychological *science* developed, it became clear that human beings could no longer be shown simply as heroes and villains The study of human character demanded the examination of motives and causes rather than the making of moral judgments To find the cause of action meant probing into the secrets of individual psychology George Meredith (1828–1909) was one of the first to apply psychological methods to the analysis of his characters For the average reader the brilliance of such novels as 'The Ordeal of Richard Feverel' or 'The Egoist' is obscured by the absence of plot and the subtleties of the language Meredith was also a poet of considerable merit, and his essay on comedy and the comic spirit is a masterly interpretation of the function of comedy in literature

Thomas Hardy (1840–1928) brought to fiction a philosophical attitude that resulted from the new science He believed that the more science studied the universe the less evidence was found for an intelligent guiding force behind it If there is just chance—meaningless blind force—in the universe what hope is there for mankind? In a series of great novels from 'The Return of the Native' (1878) to 'Jude the Obscure' (1896) Hardy sought to show how futile and senseless is man's hopeless struggle against the forces of natural environment, social convention and biological heritage (*See also* Hardy)

Romance and Adventure in 19th-Century Fiction

Not all late 19th century fiction falls into this intellectual or scientific classification Robert Louis Stevenson (1850–94) wrote stories in a light mood His novels of adventure are exciting and delightful 'Treasure Island', 'Kidnapped' 'The Master of Ballantrae' Not all Stevenson's fiction was written for young folks 'David Balfour' and The Strange Case of Dr Jekyll and Mr Hyde are quite suited to adult tastes As a short-story writer Stevenson ranks high In light verse and in the informal essay Stevenson was unusually successful (*See also* Stevenson)

One of England s most popular writers was Rudyard Kipling (1865–1936) He glamorized the foreign service in poem and story He satirized the English military and administrative classes in India He stirred the patriotic emotions of the empire lovers He wrote delightful children s tales He was, however, neither a cheap versifier nor a vulgar imperialist Whoever has not read 'Barrack Room Ballads', 'Soldiers Three', 'The Jungle Books', and 'Captains Courageous' has a treat in store for him (*See also* Kipling)

Lewis Carroll (Charles Dodgson) (1832–98) belongs in a category by himself 'Alice's Adventures in Wonderland' (1865) combines fantasy and satire in an inimitable way to the immense satisfaction of generations of old and young (*See also* Carroll)

19th Century Drama

DRAMATIC literature did not flourish in the 19th century Romantic poetry had its dramatic phases and Shelley and Byron both wrote verse-dramas These were *closet-dramas*, intended for reading rather than for stagings Several of Tennyson's plays were produced on the stage Browning's dramatic monologues and

several long dramatic poems testify that the desire to write drama was still alive. Swinburne also wrote poetic dramas. But the stage was primarily interested in producing low melodrama and sentimental farce-comedy. Musical comedy achieved respectability and distinction when William S. Gilbert (librettist) teamed up with Arthur Sullivan (composer) in 'Trial by Jury' (1875). Many successful collaborations followed.

As was the case with the readers of fiction, part of the theater audience matured. It was ready for satire, for serious treatment of social problems, and for drama that was well constructed. From the continent came the work of Henrik Ibsen (1828–1906)—realistic, intellectual, and socially significant (*see* Ibsen).

The first English dramatists to attempt the "new drama" were Henry Arthur Jones and Arthur Wing Pinero. Neither of these men could compare in wit and brilliance with two young contemporaries. Oscar Wilde (1854–1900), also a poet and novelist ('Picture of Dorian Gray'), wrote several well-made plays. 'The Importance of Being Earnest' (1895) is brittle in its humor and clever in its dialogue, but it is probably the best of his five dramas.

The plays of George Bernard Shaw (1856–1950) read even better than they act. They are important for their prefaces, which were sizzling attacks on Victorian prejudices and attitudes. Shaw began to write drama as a protest against existing conditions—slums, sex hypocrisy, censorship, war. Because they were not well received (often they were not even allowed to be presented) Shaw wrote his now famous prefaces for each play. Not until after 1900 did the Shavian wit achieve real success on the stage. Controversial ideas and Shaw productions came to be synonyms. Shaw had the longest career of any writer who ever lived. He began in the Victorian age and wrote until 1950. (*See also* Shaw.)

'ALICE'S ADVENTURES IN WONDERLAND'

Here Alice comes to visit the Mad Hatter and the March Hare in Carroll's beloved story. The picture is by Sir John Tenniel, famous illustrator of 'Alice' and 'Through the Looking Glass'.

Essayists and Historians

THERE were other great names in Victorian literature, chiefly in criticism and history. Thomas Carlyle (1795–1881) was much concerned with "the conditions of England" problem. Again and again he urged Englishmen to be "yea-sayers," to abandon negativism and indifference. In 'Sartor Resartus', 'Heroes and Hero-Worship', and 'Past and Present' he roared forth his ideas in a strange yet charming linguistic mixture still called "Carlylese." His studies of the French Revolution, of Cromwell, and of Frederick the Great mark him as a historian of high rank. Thomas Babington Macaulay's 'History of England', often inaccurate, represented a new concept of historical writing: history must be detailed, vivid, and pictorial.

Social, religious, and educational criticism was John Henry Newman's field. His writings on the nature and function of a liberal education are especially important. His 'Apologia pro Vita Sua' is one of the finest autobiographical works in literature. John Stuart Mill discussed political and economic problems. His essay 'On Liberty' is recognized as the most important discussion of that subject since Milton's time.

Of the men who wrote about aesthetic matters, John Ruskin (1819–1900) and Walter Pater (1839–94) are best remembered. Ruskin's first bid for fame was 'Modern Painters'. His art studies took him to architecture and he wrote 'The Seven Lamps of Architecture' (1849). Ruskin found that his ideas on art were at odds with social conditions. He became a reformer and thenceforth devoted his writing to social and economic problems (*see* Ruskin).

Pater, in 'Marius the Epicurean', developed a theory of beauty that ignored the social situation. This meant that art could have no ethical content, that it must be a matter of personal ecstasy.

Modern British Literature

THE GROWTH of science and technology in the 19th century had held forth the promise of a new and richer life. It became clear, however, that what man did with his discoveries and his new-found mechanical power would depend on his ability to master himself. With new inventions upsetting old ways, it became increasingly difficult to find order or pattern in life. People began to talk of the "machine age" and to ask whether it was wholly good. Could man trust science to bring a better life?

Other developments began to influence man's thought. Psychologists explored the mind and advanced all sorts of theories concerning it. Human behavior was no longer easily explainable. The new sciences of anthropology and sociology contributed to the upheaval of ideas. Religious controls and social conventions were challenged. Naturally, there were changes in literary taste and forms. Old values were replaced by new values or were lost. Literature became pessimistic, unconventional, and experimental.

Early 20th Century Writers

BEFORE 1914 the post-Victorian writers were in the unhappy position of looking back at a well marked literary road and looking ahead at a pathless jungle The comfort and stability of the past contrasted sharply with the uncertainty of the future These writers had to grapple with new forces—*sociological psychological and scientific—because they had* to live with them They were writers in transition

John Galsworthy (1867–1933) turned to the social life of an upper class English family the Forsytes and carried its history through volume after volume 'The Forsyte Saga' (1922) is an accurate though unromantic record of changing values for such a family Galsworthy also wrote a number of serious social plays including *Strife' (1909)* and *Justice (1910)* in which injustice and economic conflict form the theme (*see* Galsworthy)

Herbert George Wells (1866–1946) began his career as a writer of science fiction The Time Machine The Island of Dr Moreau and The War of the Worlds Then he turned to social and political subjects Of his many books criticizing the middle-class life of England *Tono-Bungay (1909)* a satire on commercial advertising is probably the most entertaining (*see* Wells)

Arnold Bennett (1867–1931) was a literary experimenter who was drawn chiefly to realism the choice of life approach to fiction The Old Wives Tale (1908) and Clayhanger (1910) are stories of commonplace people in drab surroundings

Out of his years as a merchant marine officer Joseph Conrad (1857–1924) wrote such remarkable novels as The Nigger of the Narcissus (1898) Lord Jim (1900) and many others The scenes chiefly of a wild turbulent sea are exotic and exciting The characters are strange people beset by obsessions of cowardice egoism or vanity (*see* Conrad)

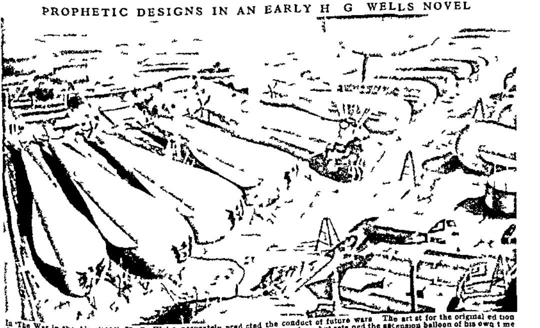
Edward Morgan Forster (born 1879) was a master of the traditional plot His characters are ordinary *persons out of middle-class life* They are moved by accident because they do not know how to choose a course of action A Passage to India (1924) is a splendid novel of Englishmen in India

Henry Major Tomlinson (born 1873) also wrote fascinating tales of faraway places in The Sea and the Jungle (1912) William Henry Hudson (1841 1922) will long be remembered for Green Mansions *(1904) a fanciful romance of the South American* jungle Hudson s skill as a nature writer surpasses his skill as a novelist John Buchan (1875–1940) who served as governor general of Canada wrote exciting novels of adventure and mystery His Thirty Nine Steps (1915) is perhaps his best known

Poets of the Early 20th Century

The poetry of the Edwardian and Georgian periods *(Edward VII 1901 10 George V 1910–36) showed* many new and unusual characteristics Robert Bridges (1844 1930) was a perpetual experimenter in verse forms He employed the usual subjects of the poet but brought strange rhythms and unusual music to his verse It is truly poetry for poets Alfred Edward Housman (1859–1936) was an anti Victorian who gave voice to the pessimism that is found in Hardy *In A Shropshire Lad nature is* unkind people struggle without hope or purpose

PROPHETIC DESIGNS IN AN EARLY H G WELLS NOVEL



In 'The War in the Air (1908) H G Wells accurately predicted the conduct of future wars The artist for the original edition A C Michael foreshadowed the shape of modern guided missiles in his airships but retained the ascension balloon of his own time

boys and girls laugh, love, and forget. A bitter poet, he was saying what many wanted to hear:

> We for a certainty are not the first
> Have sat in taverns while the tempest hurled
> Their hopeful plans to emptiness, and cursed
> Whatever brute or blackguard made the world

John Masefield (born 1878) stressed the bold, the rugged, the violent in his poetry. 'The Everlasting Mercy' (1911), a poem containing a Homeric prize fight, and 'Dauber' (1912), the story of a painter among unsympathetic seamen, will please the most masculine mind.

> Others may sing of the wine and the wealth and the mirth,
> The portly presence of potentates goodly in girth.
> Mine be the dirt and the dross, the dust and scum of the earth'

His descriptions of sea and land and of brutal people are powerfully realistic (*see* Masefield).

A different sort of poet from his contemporaries was Walter de la Mare (born 1873). The wonder and fancy of the child's world as well as the uncanniness and fantasy of the world of the supernatural were his to command. 'Peacock Pie' (1913) is representative of his verse. As a novelist and teller of tales De la Mare was a supernaturalist who believed in the reality of evil as well as in the reality of good.

James M. Barrie (1860–1937) was probably the greatest master of the romantic-fantasy drama of the period. Beginning with 'The Admirable Crichton' (1902), a butler who becomes a Swiss Family Robinson character, and continuing through 'Peter Pan' (1904), 'A Kiss for Cinderella' (1916), and 'Dear Brutus' (1917), Barrie wrote of life as seen by the eyes of childhood for an audience tired of adult viewpoints.

The Renaissance of Irish Literature

Something of Barrie's quality of fancy, garbed in more exquisite language, is to be found in the work of the Irish dramatists, poets, and story writers. Intensely nationalistic, the Irish writers were looking to their own country for literary inspiration. William Butler Yeats, John Millington Synge, and Lord Dunsany worked vigorously for the Irish cause. All were dramatists and were instrumental in founding the famous Abbey Theatre (*see* Irish Literature).

Yeats (1865–1939) wrote two beautiful plays, 'The Countess Cathleen' and 'The Land of Heart's Desire', based on Irish themes. These were followed by 'Cathleen ni Houlihan' (1902) a folk play written for the Abbey Theatre. Yeats also became one of the greater poets of his time. He was awarded the Nobel prize for literature in 1923. For the Abbey, Synge (1871–1909) wrote 'Riders to the Sea' (1904) and 'The Playboy of the Western World' (1907). Lord Dunsany (Edward Plunkett) wrote with eerie effect. 'The Gods of the Mountain' (1911) is good for suspense in any theater. His 'Tales of Wonder' (1916) are also delightful.

Others of the Irish movement were Lady Augusta Gregory, Padraic Colum, James Stephens, Lennox Robinson ('The White-headed Boy', 1916), and after the first World War, Sean O'Casey ('Juno and the Paycock') and Liam O'Flaherty. His novel, 'The Informer' (1925), later became a fine motion picture.

Impact of the First World War

EXCEPT for the Irish group, these writers have little in common Each sought his own path. None belongs to any school, yet each is in some way connected with the century that had gone. The first World War cut forever the ties with the past. It brought discontent and disillusionment to a head. Men were plunged into gloom at the knowledge that "progress" and "culture" had not saved the world from war.

The first World War left its record in literature. Rupert Brooke, who died during the war, had been idealized for a rather thin performance in poetry. Wilfred Owen, also a war casualty, was far more realistic about the heroism and idealism of the soldier. Siegfried Sassoon and Edmund Blunden, both survivors of the carnage, left violent accounts of the horror and terror of war. But people did not want to read about the war. Not until a decade had passed did English literature produce a really worth-while work about the first World War. Frederic Manning's 'Her Privates We' (1930) is a

AN IRISH FANTASY BY YEATS

William Butler Yeats's 'The Secret Garden' (1897) is typical of the literary re-creations of Irish folklore and superstitions. This picture is by the author's brother, Jack Butler Yeats.

splendid study of the decivilizing indifference to life culture and values that war begets in man

In fiction there was a sharp shift from novels of the human comedy to novels of characters Fiction ceased to be concerned with a plot or a forward moving narrative *Instead it followed the twisted and contorted* development of a single character or a group of related characters

Of these writers W Somerset Maugham (born 1874) achieved the greatest popular success Of Human Bondage (1915) portrays a character who drifts The Moon and Sixpence (1919) based on the life of the artist Gauguin continues the examination of the character without roots Cakes and Ale (1930) shows how the real self is lost between the two masks which every man wears—a public mask and a private mask

David Herbert Lawrence (1885–1930) was a man trying to find himself trying to be reborn This tragic hero c search is reflected in his curious novels about the secret sources of human life The records of his search and torment are his great novels Sons and Lovers *(1913) and Women in Love (1916)*

James Joyce (1882 1941) was searching for the secret places in which the real self is hidden He believed he had found the way to it through human vocal language To him language was the means by which the inner or subconscious feelings gained expression Civilized man tried to control his spoken language natural man would let his language flow freely If one could get this free flow of language into writing one would have the secret of that person s nature Hence the stream of consciousness that has been associated with much contemporary literature 'Ulysses (1914–22) a vast rambling account of 24 *hours in the life of Leopold Bloom and Stephen* Dedalus has immeasurably influenced modern fiction

Joyce s stream of consciousness technique was refined by Virginia Woolf (1882 1941) For her reality or consciousness is a stream Life—for both reader and characters—is immersion in the flow of that stream Mrs Dalloway (1925) and To the Lighthouse (1927) are her best works Katherine Mansfield Dorothy Richardson and Elizabeth Bowen were other experimenters in fiction of this type

While these concerned themselves with the realities of the mind Aldous Huxley (born 1894) worked with the external world With caustic bitterness he judged it and *found it false brutal and inhuman In Point* Counter Point (1928) Brave New World (1932) and After Many a Summer Dies the Swan (1939) his morbid cynicism reached its peak

Modern British Poetry

Poetry like fiction shifted from traditional form and moral pronouncements to experimental verse and new techniques The leader of the new school was T S Eliot an American who became a British citizen (*see* American Literature) In his early poetry Eliot attempted to show the gloom frustration and futility that characterized the period Such titles as 'The Waste Land (1922) and The Hollow Men (1925) show his *purpose His later poems suggest* that through contemplation humility and self-discipline man may find meaning and pattern in life

In the 1930 s one group of young poets arose who viewed the world with clearer eyes They are in Carlyle s phrase yea-sayers rather than cursers *and complainers at life* They have hope but little optimism Of this group Stephen Spender C Day Lewis Louis MacNeice and Wystan Hugh Auden are the most *effective Theirs is a program of action not* one of defeatism Each of them experimented with rhyme rhythm imagery language symbols and allusion The result was an uneven poetry that more nearly represents the unevenness of life

Another group of poets like the surrealists in art and the stream of consciousness novelists sought to escape from the world of ideas and problems William Empson and Dylan Thomas for example found their inner chaos best expressed in vague ambiguity Precision and exactness represent a departed world To day s chaos they said is better portrayed through the confused the irrelevant and the inexact

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Zangwill, Israel (1864–1926), novelist and dramatist—'Children of the Ghetto'; 'Dreamers of the Ghetto'.

PICTURES *for* ALL *Through the* ENGRAVER'S ART

Albrecht Dürer was one of the masters of engraving on wood and etching on copper. This print, The Holy Anthony, is one of his finest engravings; like most of his work it is signed with his monogram. The picturesque city is Nuremberg.

ENGRAVING AND ETCHING. Have you ever walked past a print in the school library or in some art gallery and asked yourself how that print was made? Have you often wondered how it was possible to reproduce the artist's original design so faithfully?

All prints or printed pictures are made in one of two ways: first, they may be printed directly from a plate or block or stone in which the artist has himself cut or worked the design; second, they may be made by some method in which mechanical processes are substituted for the hands of the artist. Some artists make a sketch on paper before they start work on the plate, but many draw directly on the plate.

As the artist works on the plate he pulls proofs from time to time to see how the picture is progressing. Some of these proofs will be rough working proofs not worth saving. But soon the design will be far enough advanced so that the proofs are artistically significant; then the artist may pull a number of "artist's proofs" and even sign his name on the margin of the print. If the artist pulls a number of proofs at one time at a recognizable stage in the development of the picture, he has established a "state." These are called "first state," "second state," and so on as changes are made to improve or repair the plate.

Formerly it was the practise for an artist to sell proofs of various states—the earlier states with the finest lines and most delicate shading being the most desirable. In commercial practise today an artist seldom disposes of any proofs until his work is finished; then he prints an edition, which may be as small as 10 or as many as 150, depending on the demand; such an edition is called the "published state."

No matter whether the plate is made by the artist himself or is reproduced by a photomechanical process, every print is the result of a printing process; that is, the printing surface is covered with ink and an impression is made on paper, vellum, or other suitable material. A plate is made by one of three processes: relief, intaglio, plane or surface.

In *relief* plates the spaces which show white are cut away, leaving the design on the face of the plate to catch the ink.

In *intaglio* plates the design which is to be printed is cut into the plate, and the ink must be forced carefully into every depression or part of the design. The surface of the plate, which is to show white, is then wiped clean, leaving ink only in the incised design.

In plane or *surface* prints the design to be printed and the white spaces are on the same surface. The plate is treated chemically so that the design holds

the ink, while the white spaces repel ink instead of retaining it (*see* Lithography).

Relief prints are commonly made from blocks of wood, metal, or linoleum. Intaglio prints, in the form of etchings or engravings, employ copper; and plane prints, for lithographs, stone. Other materials, such as zinc, steel, wood, or linoleum, may be used in place of copper for intaglio; and zinc, aluminum, or glass are sometimes used for plane prints.

A GREAT GENERAL, BY A GREAT ENGRAVER

Robert Nanteuil, who engraved this beautiful portrait of Turenne, marshal of France, was the foremost of the 17th-century line engravers in France and one of the greatest engravers of all time. Note the exquisite texture of the hair and the sheen of the armor.

Wood Engraving

Engraving in relief is done on such hard woods as boxwood, or on softer beech and apple woods. The block is cut with the grain and about an inch thick. The artist draws his design on this block as though he were looking at it in a mirror. The reversed image on the block thus prints a correct impression on paper. If he is copying a design, he transfers a tracing face down on the wood. The artist cuts deep in the large spaces between the lines of the design. In small spaces, as in shading, he cuts down about one-sixteenth of an inch. This is called *black-line* work, because the printing is done by the lines left standing.

Chiaroscuro prints are named from Italian words meaning "clear-dark." They combine an impression from a black-line block with an overimpression from another block that prints broad surfaces. Thus a clear black outline is toned down with lights and shadows. Chiaroscuro was used as early as the 16th century in Italy and Germany.

In another method called *white-line* engraving, the design is cut into the wood. The artist uses a single tool called a "graver," which looks like a chisel. He works with a block of wood which is sawed against the grain. By cutting down to various depths, he is able to produce tints or shades.

The earliest European woodcuts we have were probably made before 1400, but the earliest dated one, a Virgin Mary probably of German origin, was made in 1418. Woodcuts were first used as substitutes for the costly hand miniatures that decorated medieval manuscripts (*see* Books and Bookmaking).

In the early history of wood engraving, the greatest names are Durer and Holbein (*see* Durer; Holbein). Durer was the first to make wood engraving a fine art. He saw possibilities, which earlier artists had neglected, in using lines instead of tones. Holbein used few lines, but each line had great force and directness. His 'Dance of Death' and his illustrations for Luther's German translation of the Old Testament are outstanding artistic achievements.

After the 16th century the great artists generally abandoned the woodcut for other methods of engraving. In the 18th century Thomas Bewick revised the art and made white-line engravings of great beauty. He was followed by Alexander Anderson, an American who was almost as skillful as Bewick. The most outstanding recent Americans are Timothy Cole, famous for his accurate reproductions of paintings; Rudolph Ruzicka, who combines a delicate line with solid yet graceful masses; and Rockwell Kent, whose many woodcuts show a strong individual style, marked by vivid contrasts between whites and shadows.

The Intaglio Process

The simplest of the many intaglio processes is line or *burin* engraving. German or Flemish goldsmiths developed it early in the 15th century and it was practised in Italy by 1460. After the smith had decorated a piece of gold or silver plate with an engraved design, he would often fill the lines with black enamel to bring out the pattern. The Italians called this style *niello*, or black work. The original line engravings are "rubbings" or prints taken from the engraved plates before the lines were filled with enamel. They were used to judge the quality of the design.

The line engraver uses a graver called a "burin," which gouges a V-shaped line. The fine shavings along the edge of the groove are removed by a scraper. The engraver can vary the depth of the groove, and thus make the groove print blacker or fainter, as he desires. This is in contrast with the raised woodcut lines, which print lines of equal intensity.

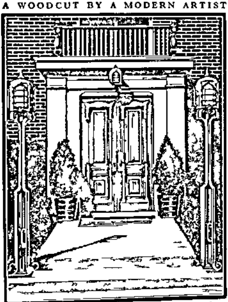
Line engravings are usually made on copper, because copper is hard enough to stand the pressure of printing and soft enough to be worked by the engraver. For a plate the size of this page, the copper should be about an eighth of an inch thick. Other metals may be used, but only copper, steel, and zinc are used in commercial engravings.

Before the engraver starts to draw on the plate, he varnishes it to provide a working surface for his pencil or crayon. As with woodcuts, the engraver draws his design directly on the plate, or transfers it from a sketch. When the drawing is on the plate, he cuts away the lines with the burin. The grooves are very shallow, and even the slightest scratch will print.

Steel engravings on steel plates are usually produced by etching but the graver also is used The chief advantage of this process which is employed mostly in printing stamps paper money and bonds lies in the larger number of prints that can be made from the harder metal and in its clean sharp outlines

The printing of an engraving is more difficult than that of a woodcut Great care must be used in getting the ink into every part of the design and then in wiping clean the rest of the plate The ink is rather thick or stiff and to soften it both the ink and the plate are heated slightly before printing The special press for printing engravings operates like a clothes wringer Above the plate and almost touching it is a horizontal cylinder The bed of the press on which the plate is laid face up runs on rollers By turning a crank the printer forces the bed and the cylinder in opposite directions thus exerting great pressure This pressure causes the edges of the plate to leave a mark on the paper, called the plate mark

A WOODCUT BY A MODERN ARTIST



This woodcut shows the doorway of the building where your Compton's Pictured Encyclopedia is published It was designed and executed by the noted American engraver Asa Cheffetz Notice how the broad light colored entrance is set in contrast with the dark details of the bricks and shrubs

The honor roll of master engravers begins in 15th century Italy with Mantegna and in 16th century Germany with Durer and Holbein Mantegna is distinguished for the strength and sharpness of his burin-cut lines and for his classical subjects Durer had a genius for detail exemplified by his Melancholy which is regarded by many as the finest engraved print in existence The classical period of line engraving came in the time of Louis XIV At his court arose a school of portrait engravers of whom Nanteuil Masson Edelinck and Pierre Drevet were foremost who combined great skill in rendering character with a marvelous technical proficiency in reproducing the texture of hair fur silks armor and other materials

How the Etcher Works

The word etching comes from the Dutch *etsen* (to eat) An etching is really an engraving in which the design on the metal plate usually copper is eaten away by an acid First of all the etcher covers the plate carefully smoothed and polished just like one for a line engraving with a ground which is a compound of beeswax and other substances When the ground is hard it will resist acid The dry ground is still transparent and is usually smoked over a candle or gas flame so that the design will be easily seen On this black surface the etcher lightly pencils the picture Then he takes his etching needle which is like an ordinary sewing needle but set in a wooden handle and cuts away the ground along the lines of the picture but not the metal itself When the complete design shows against the black ground the plate is ready to be etched

Etching is done by immersing the plate in a shallow dish or tray filled with a *mordant* (from the French to bite) For this purpose various acids are used preferably a solution of nitric or of hydrochloric acid The acid slowly eats away the copper in the lines thus saving the artist the trouble of gouging out the metal When the artist is satisfied that the biting has gone far enough he rinses the plate in clear water dries it and removes the etching ground with turpentine Printing an etching is done in the same manner as a line engraving but much more depends on the skill and taste of the printer He may leave a little ink on parts of the plate not etched or he may rub one section of the plate cleaner than the rest thus heightening the effect Ink deliberately left on the plate in this way and not a part of the design is called retroussage

The earliest known etching was made on iron in 1513 by a Swiss artist Urs Graf and within the next 15 years the practise of etching became common Among early etchers the great names are Albrecht Durer Jacob Ruysdael Jacques Callot Claude Lorrain Sir Anthony Van Dyck Guido Reni José Ribera and Salvator Rosa Generally considered greatest of all etchers is Rembrandt (*see* Rembrandt) Whether we consider his landscapes like the famous Three Trees his dramatic representations like Christ Healing the Sick or the numerous portraits of rich and poor old and young all alike are illuminated by a power which never fails to pierce to the heart of things

Among later etchers one of the greatest names is the Spaniard Francisco Goya His series of etchings on Disasters of War and on bull fighting (Tauromaquia) are famous for their satirical spirit no less than for their technical brilliance Charles Méryon and Anders Zorn stand in the first rank of etchers of all time Méryon was color blind and unlike most etchers could not paint in oils or water colors He worked over most of his plates in many states sometimes seven or eight until he finally realized the

perfection that he sought. The 19th-century French painters of the Barbizon school—those who painted at the little village of Barbizon on the edge of the Fontainebleau forest—were also skilled etchers. Among them were Theodore Rousseau, Charles Jacque, Charles François Daubigny, Jean François Millet, and Camille Corot. Alphonse Legros, a Frenchman, and James McNeill Whistler, an American, spent most of their lives in England. They largely fixed the style of English etching in the late 1800's. Among modern American etchers, Joseph Pennell's work shows the trend toward industrial and city scenes.

WOODCUT BOOKPLATE AND ITS IMPRESSION

Reynolds Stone, noted English engraver, made this woodcut. The incised lettering takes no ink, forming a white pattern on paper.

Dry-point etchers use no etching ground or acid. They cut the line directly into the plate with a metal needle that is sometimes tipped with a diamond or ruby. They draw the needle toward them, and as it plows the metal it leaves a "burr" of curled shavings on each side of the line. In line engraving, this burr is scraped away. In dry-point etching, the burr is allowed to remain. When inked, the burr imparts a warm, velvety line to the impression. This gives dry-point etching its distinctive quality. Since the burr is delicate and wears down easily, the first impressions from the plate are the best.

Mezzotints and Aquatints

In mezzotint ("half tint") engraving, the engraver first covers the metal plate with small, evenly distributed depressions. He does this with a *rocker*, a curved piece of metal with projecting points. This is rocked across the metal until the entire surface is roughened. Using a blunt scraper, the engraver then scrapes his design on the surface. He works by smoothing out or deepening the depressions. Where the depressions are entirely erased from an area, the paper on the print will remain white, since there is nothing on the surface to hold ink. The shallow depressions print the light tones, and the deeper depressions reproduce the heavier tones. The engraver thus works out a design that can print every gradation of tone between black and white.

The best mezzotints were made in England in the 1700's. A remarkable group of engravers reproduced the paintings of Gainsborough, Sir Joshua Reynolds, and others by this method. One painter of the time, Joseph Turner, was also an accomplished engraver. He made many landscape studies, using a combination of mezzotint and etching techniques.

Aquatint ("water tint") and stipple were much used in the 1700's and early 1800's but are now rarely practiced. Aquatinting was popular for reproducing watercolors and for making original landscapes. Stipple was largely used for portraits. There is one main difference between aquatinting and etching. In aquatinting, areas that are to leave white space on the paper are coated with varnish, or "stopped out," on the ground. This brushed-on varnish eliminates any gradations or shadings within or on the edges of the stopped-out areas. Aquatint is often used in combination with other etching processes.

In stippling, the plate is covered with an etching ground. Then the design is "picked out" in dots with needles of various sizes and shapes. The darker portions of the design are made by larger dots. These dots are then bitten (etched) into the copper plate by an acid. Delicate gradations in light and shadow can be achieved by this method.

How to Identify Prints

A relief, usually a woodcut, print has no plate mark; that is, the edges of the plate do not indent the paper. An intaglio print has a clear, sharp plate mark. In a lithograph the plate mark is slight, but you can see it by holding the print horizontally with the eye. Although there may be no apparent ridge of paper at the edge, the paper will appear to be smooth where the stone or plate has pressed it.

Another test is to feel the paper. If the ink stands out, an engraved plate was probably used. If the ink is flat, the plate is a woodcut or a lithograph. Sometimes these two are hard to distinguish, but usually ink used on woodcuts is shiny, while lithographic ink looks more or less grayish.

A close study of the lines themselves will reveal the difference between an engraving and an etching. The lines in an engraving vary gradually in thickness; in an etching they widen or narrow abruptly. In an engraving the lines taper gradually at the ends; in an etching they stop squarely. In general, if the lines are massed, strong, and regular, many of them parallel, it is probably an engraving. If the lines look free and sketchy it is probably an etching. These distinctions are mainly due to the fact that the line engraver works on the metal itself and the etcher works on the much softer ground. A dry-point etching line has the distinctive soft edge left by the burr.

Generally a woodcut line is simpler and broader in effect than an engraved line. Its edges are too clean to be confused with an etched line. A print which is composed of little dots is probably a stipple. Aquatints appear flat, with only a few gradations of tone or shade, and each of these is separate. In mezzotint the tone is rich, with delicate gradations from light to dark.

ENZYMES. Catalysts start chemical reactions or control the reaction rate without being affected themselves. Enzymes are the catalysts of chemical reactions in living matter. They play a major role in respiration and in the digestion and use of food in the bodies of plants and animals.

Enzymes are made in living cells. Some of them apparently consist entirely of protein. Others seem to be protein combined with other substances. Whatever the composition, each kind of enzyme has its own particular function.

One class of enzymes, called digestive enzymes, helps plants and animals digest food. They are present in the digestive systems of plants and animals. They help break down foodstuffs into simpler forms which the body can absorb. They act on proteins, starches, sugars, and fats.

A chemist working in a laboratory can break down these same substances in his test tubes. To do so, however, he may have to use more heat than living plants and animals could stand or he may have to use poisonous acids or alkalis. Even with these agents, the break-down reactions are slow. In the digestive systems of plants and animals, because of the presence of enzymes, the reactions take place quickly and efficiently, without great heat and without strong acids or alkalis.

Ptyalin is a digestive enzyme in the saliva. It breaks down the complex molecules of starch into the simpler molecules of sugar. It is an enzyme of the type called *amylase*: "amyl" is from the Latin word "amylum," meaning starch, and "ase" indicates an enzyme. *Diastase* is a vegetable amylase which helps plants turn starch into sugar. *Pepsin*, an enzyme in the stomach, breaks down proteins. It is one of the enzymes called *proteinases* because they act on proteins. *Bromelin* is a proteinase present in pineapples. The table lists other digestive enzymes.

Enzymes and the "Burning" of Food

Enzymes also help plants and animals to get the energy out of food. Energy is freed from digested food by oxidation in the individual cells of the plant or animal. In this process oxygen (usually from air) reacts with molecules of sugar, protein, or fat to liberate the energy they contain. This kind of oxidation is often compared to another kind, ordinary burning. If a chemist burns a foodstuff in his laboratory, however, the heat produced is so great that it would kill living cells. In plants and animals oxidation takes place slowly through a series of chemical reactions which release heat and energy step by step in small amounts. Enzymes make this kind of oxidation possible. (*See* Food, section "How Different Foods Build Health and Strength.")

Enzymes enable yeasts and certain bacteria to oxidize food without the help of oxygen from the air. The process is called fermentation. Fermentation of sugar by yeast was formerly considered to be a single chemical reaction catalyzed by one enzyme, *zymase*. It is now known to be a series of reactions involving at least 12 enzymes. (*See also* Respiration.)

The enzymes mentioned are only a few of the scores which plants and animals make and use. Enzymes take part in photosynthesis (the making of food by plants), germination of seeds, manufacture of blood cells, contraction of muscle, and every other vital process. To biochemists these catalysts of life present fascinating problems. No one knows *how cells make* enzymes. No one entirely understands the structure of enzymes. Although more than 40 different kinds have been separated from living matter as proteinlike crystals, many of the ways in which enzymes work remain a mystery.

Enzymes in Commerce and Industry

Enzymes are important in a number of businesses concerned with food. Some enzymes go on working after a fruit has been picked or an animal has been butchered. Fruitgrowers therefore can pick bananas, oranges, and other fruits while they are still green and let them ripen during shipment to market. Meat packers can tenderize meat by aging it carefully. Cheese manufacturers use rennet, a digestive enzyme prepared from calves' stomachs, to curdle milk.

The fermentation industries all depend on the action of enzymes, since it is the enzymes in yeasts and bacteria that accomplish fermentation. Among the products of these industries are beer, wine, whisky, grain alcohol, butyl alcohol (used in making lacquers and synthetic rubber), and vinegar. The industries use cultures of organisms rather than crystallized enzymes to cause fermentation because the latter work more slowly. (*See also* Yeast, Alcohol.)

SOME IMPORTANT DIGESTIVE ENZYMES

Enzyme	Source	Acts Upon
Aminopeptidase	Intestine	Peptides (amino acid compounds)
Amylopsin (pancreatic amylase)	Pancreas	Starch
Bromelin	Pineapple	Protein
Carboxypeptidase	Pancreas	Peptides
Cathepsin	Animal cells	Protein
Cellulase	Bacteria and fungi	Cellulose
Chymotrypsin	Pancreas	Protein
Diastase (vegetable amylase)	Seeds, malt	Starch
Dipeptidase	Intestine	Peptides
Invertase	Intestine, plant cells	Sucrose
Lipase	Stomach, pancreas, intestine, plant cells	Fat
Maltase	Widely distributed in animal secretions and plants	Maltose
Papain	Papaya	Protein
Pepsin	Stomach	Protein
Phosphatase	Plant cells, various animal tissues and secretions including bone, blood, bile	Carbohydrate-phosphate combinations
Ptyalin (salivary amylase)	Saliva	Cooked starches
Rennin, also called chymosin or rennet	Stomach	Milk (curdles it)
Steapsin (pancreatic lipase)	Pancreas	Fat
Sucrase, same as invertase		
Trypsin	Pancreas	Protein

EPICTE'TUS. In his youth Epictetus, the Greek Stoic philosopher, was a slave. His real name is unknown; Epictetus means "acquired." He was born in Phrygia about A.D. 60, and when he was a boy he became the property of a Roman. In Rome, the slave managed to attend lectures on philosophy. After he won his freedom, he became a teacher.

About A.D. 90 Emperor Domitian banished all philosophers from Italy. Epictetus went to Nicopolis, in Epirus, where he taught the doctrines of Stoicism. His teachings were based on freedom of the will, trust in Providence, and obedience to conscience. Arrian, his favorite pupil, took down much of his philosophy and preserved it in two treatises, the 'Discourses' and the 'Handbook'.

EPSTEIN, JACOB (born 1880). Through his long career as a sculptor, Jacob Epstein drew storms of criticism. Each new carving in stone or marble was greeted with cries of "ugly!" or "deformed!" Gradually many people would learn to appreciate the rugged strength of the new work, but the same argument began again when Epstein showed his next statue. Over the years, however, Epstein won many admirers, and today his place in modern sculpture is assured.

Epstein also made many portrait busts of well-known people. These were modeled in clay, then cast in bronze. The busts have been accepted with less argument, because Epstein worked to achieve realistic likenesses. Among his famous subjects were George Bernard Shaw, Albert Einstein, and Winston Churchill. He also did many charming portrait busts of children. (*See also* Sculpture.)

The sculptor was born Nov. 10, 1880, in New York City's East Side. His schoolteachers, impressed by his talent for drawing, did not scold him for neglecting other subjects. At 20 he entered the Art Students' League to study drawing and painting. Soon he turned to sculpture. He worked days in a foundry that made bronze casts and studied sculptural modeling at night. He went abroad to study in London and Paris, and in 1905 he settled in London permanently. The next year he married Margaret Dunlop, a Scotswoman, and later he became a British subject. The Epsteins had two children.

His early portrait busts won recognition, and he was commissioned to make 18 figures for the outside walls of a new public building. When they were unveiled, the arguments over Epstein's ability began. Undiscouraged, he continued to carve his massive and often grotesque figures. In them he expressed what he called the "intimate and deeply human" problems of man. From time to time Epstein drew book illustrations and painted. In contrast to his sculpture, his pictures are delicate and appealing.

'MEXICAN GIRL'

This picture shows only the head and shoulders of a larger figure by Jacob Epstein, whose works have aroused much controversy.

EQUINOX AND SOLSTICE. Twice a year—once about March 21 (the vernal equinox) and again about September 23 (the autumnal equinox)—the poles of the earth are equidistant from the sun, and day and night are equally long. The latter fact gives rise to the name equinox (from Latin *aequus*, "equal," and *nox*, "night"). The equinox does not last an entire day and night. It occurs at the exact instant when the line of intersection between the planes of the earth's orbit (the ecliptic) and its equator sweeps through the centers of the earth and the sun. The clock time of this varies according to one's location on the earth. The time varies also from year to year because the earth does not complete its journey around the sun in an exact number of days, and also because of the procession of the equinoxes. Equinoxes and solstices occur about 5 hours 55 minutes later each year. The vernal equinox usually comes later and later on March 21, then drops back to March 20 every leap year, with corresponding times for the autumnal equinox and the solstices.

The solstices ("standing still" of the sun) come midway between the equinoxes—the summer solstice, on June 21 or 22, when the North Pole is nearest the sun, and the winter solstice, on December 21 or 22, when the South Pole is nearest the sun. (*See also* Calendar; Earth; Seasons.)

ERIC, THE RED. About A.D. 982 a brawny, red-bearded Northman named Eric set sail from the northwest coast of Iceland. Eric had killed a neighbor in a quarrel and for his crime he was sentenced to be banished from Iceland for three years. He was intending to sail his Viking craft west to a land that he had heard of but had never seen.

About a hundred years before, a mariner named Gunnbjörn had been blown off his course from Norway to Iceland. Beating his way back, he had sighted a bleak, snow-covered land. Men told tales of Gunnbjörn's discovery, but no one had returned to explore the unknown country.

Into his long open boat Eric loaded his family, his servants, his slaves, and a few friends. They took supplies, cattle, sheep, and horses. For days they sailed through the fog and rough water of the North Atlantic. At last the east coast of the new land loomed up before them. Icebergs and drifting sheets of ice barred their landing, so they rounded the southern cape of the island and found an ice-free shore on the west coast. There they beached the long boat and set foot on the huge island that Eric named Greenland (*see* Greenland).

Eric and his people found country much like their own Iceland. They built houses and barns and raised fodder for the livestock. They fished in the ocean waters and lived as they had done at home. At the

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LANDING ON GREENLAND'S ICY SHORE

A snow flurry swirls about Eric, the red-bearded Northman, as he surveys the bleak coast of Greenland. Here he and his family must spend three years in exile away from their native Iceland.

end of his three-year exile, Eric returned to Iceland to persuade others to come and live with him in Greenland. In 986 he returned to Greenland with about 500 new settlers. They built two colonies which grew and prospered.

Eric had two sons, Thorstein and Leif. Leif became famous in history as the first European who touched the North American continent (*see* Ericson). Most of what we know about Eric comes from an old Icelandic story, the 'Saga of Eric the Red'.

ERICSON, LEIF. Through the fog-shrouded waters of the North Atlantic in the year 1000, a Viking ship moved slowly. The captain, young Leif Ericson, held his place at the rudder, while the crew peered anxiously for the sight of land. They had been watching like this for many days. The ship, sailing from Norway to Greenland, was long overdue to make port.

Finally they sighted a coast. Leif headed the ship for shore, and soon he and his men were on land. They knew at once that this could not be their barren Greenland home, for here heavy forests grew close to the beach. These Norse sea rovers had actually found the coast of North America. Although they did not know it, they were probably the first white men to set foot on the American mainland.

Further inland the Northmen found wild wheat growing in open fields. Vines were heavy with sweet berries that could be pressed into wine. The tall trees in the forests could be cut into long timbers. Leif and his men gathered samples of all these and returned to their ship. Because of the berries, Leif called the new land Vinland ("wine land").

Today no one knows exactly where Leif landed. It may have been along the Gulf of St. Lawrence or in Nova Scotia. Many historians believe it might have been on the New England coast or even farther south. On his way back to Greenland Leif rescued a number of shipwrecked voyagers. For this deed he was called Leif the Lucky.

Leif was the son of Eric, the Red (*see* Eric, the Red). He was born in Iceland about the year 980. When Leif was two years old, Eric took his family to Greenland. Like most Northmen Leif went to sea as a boy. When he was 19 his father gave him a ship, and Leif voyaged to Norway. Norway's Christian king, Olaf Tryggvesson, invited Leif to spend the winter at his court. Leif did so and in time became a Christian. When he set sail for home, he took two priests along to teach Christianity to the Greenlanders.

Leif was in a hurry to get home so that the priests could meet that year's parliament. He decided to sail without stopping at any of the islands that lay between. In his haste he got off his course, and wind and current carried him to his discovery of America. When he finally got home he converted his mother to Christianity, and she built the first church in Greenland.

Later, Thorfinn Karlsefni, an Icelander who had married the widow of Leif's brother, founded a colony in Vinland. Within a few years the Indians drove the white settlers away. On the way to Vinland Karlsefni's party had stopped farther north at a place they had named Markland. For more than 300 years after Vinland was abandoned, Greenlanders continued to go to Markland for timber, but little news of their discovery reached the rest of Europe.

ERICSSON, JOHN (1803–1889). The Swedish-American inventor and engineer, John Ericsson, became famous through his construction of the ironclad *Monitor* (*see* Monitor and Merrimac). But he was not a man of one invention, nor was he unknown. As a boy in Sweden he showed a mechanical bent very early. When he was 12 years old he was apprenticed as a draftsman. From 1820 to 1827 he was in the Swedish army where his excellent military maps won him a captaincy. Then he obtained leave to go to London. In partnership with John Braithwaite he competed for a prize offered for a steam locomotive by the Liverpool and Manchester Railway Company. The prize was awarded, however, to George Stephenson (*see* Stephenson). So Ericsson turned to other experiments and soon completed a number of marine inventions. He built a new kind of naval engine which was to be placed below the water line and won

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a prize of $20,000 from the British admiralty for the invention of a screw propeller. In 1838 he designed the engines and propeller used by the first vessels to cross the Atlantic in regular steamship service.

The United States government ordered an iron vessel at a British shipyard to be fitted with his screw and engines. Ericsson followed the ship across the Atlantic and established himself in New York in 1839 as a shipbuilder. Finally his inventions brought him a large fortune. His most notable achievement was building the *Monitor*, called at first an iron-clad "cheese-box on a raft." The ship and its revolving gun turret revolutionized naval construction. Later he worked with torpedoes and solar-heat motors.

JOHN ERICSSON

As the designer of the *Monitor*, Ericsson ranks as one of the great shipbuilders in history.

Ericsson became an American citizen in 1848. When he died in 1889, a United States warship took his body to Sweden for burial.

ERIE, LAKE. The shallowest and stormiest of the Great Lakes is Lake Erie. So many ships were wrecked on it in past times that it has been called "the marine graveyard of the inland seas." The surface is 572 feet above sea level and the greatest depth is only 210 feet. The lake is fourth in size among the five Great Lakes. Its length is 241 miles and its area is about 9,940 square miles.

Despite its small size, Erie has four of the seven major lake ports. Detroit stands at the west where the Detroit River, Lake St. Clair, and the St. Clair River enter from Lake Huron. Buffalo is at the east where Lake Erie empties over Niagara Falls into Lake Ontario. Other important Lake Erie ports are Cleveland and Toledo, on the Ohio shore. Ships can pass between Lake Erie and Lake Ontario through the Welland Ship Canal (*see* Welland Ship Canal). Major cargoes on Lake Erie vessels are iron ore and coal. (*See also* Great Lakes.)

Lake Erie was the scene of an important naval battle in the War of 1812. Offshore of Sandusky, Ohio, Com. Oliver Hazard Perry beat the British in a decisive engagement on Sept. 10, 1813 (*see* Perry).

ERIE, PA. First, cargoes of fur, and then of grain, fish, pulpwood, coal, and iron ore made Erie one of the busiest of the Great Lakes ports. Today it ships and receives millions of tons a year, much of it iron ore for the steel mills of its own and the Pittsburgh industrial areas.

The curving, 7-mile-long Presque Isle Peninsula shelters Erie's harbor. Back of the city stretch miles of gently rolling farmland. The city, modeled upon the plan of Washington, D.C., enjoys a spaciousness unusual in an industrial center. Erie's factories make electric locomotives, electrical equipment, hospital supplies, steam engines, various metal articles, rubber goods, paper, and clothing.

Points of interest in Erie include the Old Customs House, erected in 1839, now the county historical society headquarters. Commodore Oliver Hazard Perry's flagship, the *Niagara*, for the battle of Lake Erie in the War of 1812, is preserved as a memorial. Presque Isle Peninsula is one of the state's most popular parks. Erie is the seat of two Roman Catholic colleges for women and a college for men.

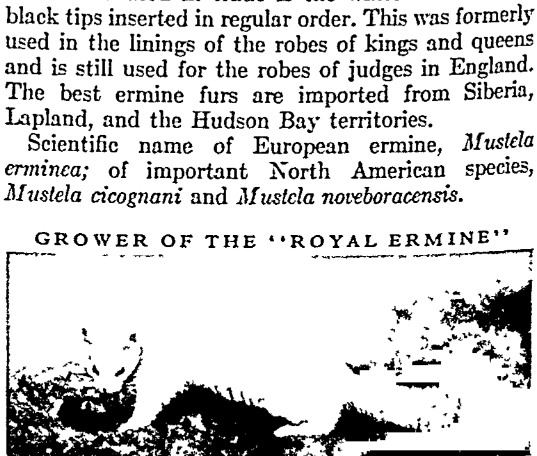
Before the Revolution, the French and British in turn held the Presque Isle harbor. Connecticut, New York, and Massachusetts claimed a triangular area that included it. These states gave up their claims to the national government, and in 1792 the government sold the area to Pennsylvania to provide that state with a Great Lakes port. Erie was settled in 1795 and named for the Erie Indians. In 1803 the village became the seat of the newly formed Erie County, and in 1805 it was incorporated as a borough. Erie grew slowly. Its early industry produced lumber, flour, bricks, and foundry products. Completion of the Erie and Pittsburgh Canal in 1844 brought heavy traffic to its ports. Erie was incorporated as a city in 1851. Its government is the commission form. (*See also* Pennsylvania; Pittsburgh.) Population (1950 census), 130,803.

ERMINE. A quick, restless, brave, and bloodthirsty little animal is this member of the weasel family, related to the mink. It has a slender body, about ten inches long, and short legs. It runs swiftly and climbs and swims well. From its home among rocks, it slips out to attack birds, rats, mice, and chickens, sucking the blood of its prey. It is found in Europe as far south as the Alps and in Asia and North America.

The ermine is valued chiefly for its fur. In summer this is reddish-brown above and yellowish-white underneath and the animal is then often called the "stoat." In winter the fur changes to a beautiful white, except the tail, which has a black tip. The ermine fur used in trade is the white fur with the black tips inserted in regular order. This was formerly used in the linings of the robes of kings and queens and is still used for the robes of judges in England. The best ermine furs are imported from Siberia, Lapland, and the Hudson Bay territories.

Scientific name of European ermine, *Mustela erminea;* of important North American species, *Mustela cicognani* and *Mustela noveboracensis.*

GROWER OF THE "ROYAL ERMINE"



From this little weasellike animal comes one of the costliest furs. Its coat changes color with the seasons, but the white "winter coat" is preferred.

How ESKIMOS *Live in Their* ARCTIC *Homeland*

ESKIMOS Scattered across the vast northern part of North America dwell the Eskimos a cheerful sturdy copper-skinned people They live in a land that is largely wild and unsettled for most other people fear the cold of the long dark Arctic winters But the Eskimos are able to make themselves so comfortable in the Arctic that they like winter better than summer

They kill the animals and fish of Arctic waters and lands for food They make warm clothes from the hides They fashion snug houses from earth rocks driftwood skins and sometimes snow They travel swiftly over ice snow or frozen ground on sledges drawn by dogs

This family of Greenland Eskimos is outside the summer home—a tent or tupek made of canvas Tents are sometimes fashioned from caribou skin or seal skin They can be easily taken down and carried on hunting trips Notice the windbreak for the mother dog and her pups

Only about 40 000 Eskimos live in all their immense homeland It stretches westward from Greenland across Labrador northern Canada and its Arctic islands the Alaskan coast and into Asia's northeast Siberian coast The northernmost Eskimo homes are on islands deep within the Arctic Circle where the sun does not shine for two or three months in winter and never leaves the sky for an equal time in summer (*see* Arctic Regions) They also live as far south as the latitude of Scotland There are wide differences in the kinds of land and climate over the vast area from the treeless northern tundra to the fringes of the evergreen forests in the south The lives and customs of the Eskimos also differ from place to place since they use what the land affords in making a living

In recent decades the presence of white settlements have led to other changes in Eskimo ways Some have moved to towns where they work at the same trades eat the same foods and wear the same kind of clothes as their white neighbors Even the hunting Eskimos of the wilderness also like to use rifles axes knives needles tent canvas and a few other factory products

How the Hunting Eskimos Live

Along the Arctic coast scattered bands of hunting Eskimos live much as their forefathers did with little help from the white man's wares They are able to get and make everything they need in a land too cold to grow vegetables and grains for food or trees for fuel and building materials

They spend their lives moving about with the seasons in search of various kinds of game They keep warm in clothing the women make from animal skins They wear an under suit of caribou skin with the fur turned toward the body and deerskin inner boots The shirt stretches up to make a hood over the head In winter the hunter wears an outer coat and trousers sometimes made of polar bearskin with high sealskin boots and fur mittens *An entire caribou outfit weighs* less than ten pounds This is lighter than the heavy woolen garments white men wear The skin garments

A WINTER HOME MADE OF SNOW BLOCKS

Snow igloos are used by certain Eskimos as temporary shelters during their winter hunts Here a Canadian Eskimo aided by his son is shaping the blocks for the entrance or hallway with his snow knife He can build a snow house in about an hour

hold the body's warmth and keep out the biting Arctic winds.

Many Eskimos build dome-shaped winter homes of sod, rock, and driftwood. They call these and other buildings *igloos*. The family creeps on hands and knees through a low, dark tunnel to enter their home. This hallway breaks the force of the wind and keeps heat from escaping. The door may be a flap of caribou hide.

The igloo's one room is about 30 feet across and 10 feet high. A platform covered with caribou skins makes a sleeping bench. The room has a ventilating hole at the top and perhaps a window of transparent seal intestine A soft cover of loose snow helps to insulate the igloo.

HARPOON POISED FOR THE KILL

This hunter has bagged one seal and is ready to strike again if another comes up to breathe through a crack in the ice. Notice the snow-shoes which the hunter has worn across the the snow-covered ice.

Food and Cooking

The lamp gives light and also serves as a cooking stove. It is a basin shaped from soapstone and filled with whale, walrus, or seal fat. Wicks of moss give off heat as well as a soft, yellowish light.

The family sits in a circle on the floor to eat the dinner of boiled seal, caribou, or fish. Breakfast, served in a hurry before the hunters depart, may be raw, frozen fish or meat. They wash down their meals with hot tea and ice-cold water. They have no fruit, vegetables, or milk. Yet by eating plenty of fresh meat and fish they get enough vitamins to avoid the scurvy which has plagued polar explorers. For dessert they may have Eskimo "ice cream." This is frozen caribou fat shaved fine and creamed with oil. Another treat is seal or whale fat, called blubber. They eat it as we do butter or bacon.

After dinner the one-room igloo becomes a bedroom. Family and guests curl up on the floor or sleeping bench and go to sleep.

Making Clothing and Weapons

They have plenty to keep them busy during their waking hours. The women dress animal skins and make the clothing for the family. They are skillful furriers and sometimes trim the garments with contrasting furs, fringe, or beads. They sew bird skins together to make summer garments. They may sew with bone needles, using sinew for thread, or get steel needles, cotton thread, scissors, and knives at a trading post.

The men make boats, sledges, snowshoes, and some of their weapons. Most of them have come to depend on rifles from a trading post for hunting. With this weapon, they can supply more food and skins for family use and meat for the hungry dog teams.

Winter Travel and Hunting

In winter the Eskimo travels on a dog sledge, or *komatik*. He lashes together slats of driftwood and crosspieces of bone to make a light yet sturdy frame. The sledge rests on runners of walrus ivory. On the trip, he may spray water on them. The ice makes them glide more easily. The sledge is pulled by a team of dogs, guided by a well-trained lead dog. Such a team can haul a hundred pounds or more to each dog. The driver may sit on the sledge or trot beside it. Sometimes a member of the party runs ahead to encourage the team.

When the Eskimos go on hunting trips, they often build temporary igloos from blocks of snow. These houses are warm because the air in the snow makes it a first-rate insulating material.

REINDEER GRAZING THE ALASKAN TUNDRA

Many Eskimos in Alaska and Canada now make their living by tending herds of reindeer like the one shown above. These swift animals provide the herdsmen with milk, meat, and hides for clothing.

The hunters push far out on the thick ice that covers the sea to get a lumbering polar bear or a fat walrus. They value the walrus for its meat and its ivory tusks. They make harness from its tough hide and burn its oil in lamps. The chief game along most of the Arctic coast is the seal. The hunter sits patiently for several hours at an air hole in the ice waiting for a seal to come up to breathe. Then he stabs it with his sharp-tipped harpoon (*see* Seal).

Eskimos often set a line of traps far out over the snowy countryside. They must visit these traps regularly. When they find a fox trapped they quickly skin it and carry the furs back home to be cleaned and dried. In the spring they take the pelts to the trading post to exchange them for tea, flour, sugar, rifle cartridges, cloth, and other supplies.

Spring Hunting in the Arctic

The long days of spring and summer find the Eskimos hunting and fishing continually to store up food and get enough skins for new clothing. The winter house leaks in the spring rains and becomes uncomfortable. The family moves into the summer tent which they will carry with them as they move to the rivers to fish or follow the feeding caribou. They make the tent, or *tupek*, cover from caribou skins or from canvas bought at the trading post. They stretch it over driftwood poles.

Traveling is difficult after the summer thaw. The top layer of ground is spongy, muddy, and full of pools, for the subsoil stays frozen. Mosquitoes and other insects swarm from the soggy earth and make life miserable for people and animals. But the fast-growing tundra plants spring into leaf and bloom, providing food for migrating animals and birds.

When the Eskimos of an area hear that a herd of caribou has been seen migrating to the summer feeding grounds, the families pack their belongings and set off on the hunt. The women and children help by surrounding the caribou and herding them into a deep, narrow valley. The men and boys steal in for the kill. They skin the dead animals and cut them up. They hang the meat on racks to dry. The women clean the skins and start making the new winter clothing.

When the ice breaks up in the bays and inlets a band may go out on a whale hunt. They have only crude weapons and light boats, and so they must use great skill and care to avoid being upset and killed by the huge animals. A whaling party of eight or ten rides in the big open boat called a *umiak*. Its strong, well-balanced frame is made from spruce driftwood and it is covered with whale skin.

DRESSED TO KEEP OUT THE ARCTIC COLD

Top, the Eskimo mother carries her baby inside her warm fur parka. Notice that this woman wears factory-made garments beneath her deerskin jacket instead of the snug fur trousers that belong with the native outfit. Bottom, the Eskimo snowhouse builder looks very bulky in his layers of fur clothing. Moisture from his breath has frozen about his mouth.

The hunters kill the whale with a harpoon, a long spear-like weapon with a detachable steel point. A drag and an inflated sealskin bag hang on the harpoon. They help exhaust the wounded whale. After it dies the bag floats on the water to mark the whale's location.

When the men go out on the sea to hunt walrus or seal they use a waterproof canoe called a *kayak*, made of sealskin stretched tight over a bone framework. The entire boat is decked over with hide except a circular cockpit in the center. There the hunter laces himself in with a skin apron. Even if upset a kayak will not ship water and the hunter can quickly right it with his paddle (*see* Canoes).

Netting Birds and Trapping Fish

Some Eskimo groups hunt the birds that migrate north to feed during the long Arctic summer days. They gather eggs from the nests and catch birds in homemade nets. They may store the eggs in underground iceboxes for winter use. The women make bird skins into garments or line winter jacket hoods with them.

When the ice melts in summer the Eskimos fish near the rivers' mouths. They build stone barriers upstream and partial barriers downstream. After the fish swim into the trap the Eskimos close the lower barriers. Now they can easily spear the fish caught in the ponds. In some places Eskimos seine fish with nets. They also fish through the ice in winter.

An Eskimo Dance

After a hunt the women prepare a feast of caribou chunks roasted over fires of driftwood. Everyone eats *heartily*, *laughing* and visiting with his friends. Later the people sing, tell stories, or dance.

One man beats a drum made of skins stretched over a wooden hoop. Around the drummer the women squat shoulder to shoulder in a tight circle while the men recline near by. All sing a monotonous chant and *sway to* and fro to the drum beats.

The People of the Far North

Eskimos are short to medium tall and stocky, with straight black hair, black eyes, and skin about the color of that of the Chinese or other Mongoloid folk.

They are closely related to the natives (called Aleuts) of the Aleutian Islands off the Alaska coast. Scientists believe they belong to the same racial group as the American Indians. The name Eskimo was given them by their Indian neighbors to the south. It means "eaters of raw flesh" Their own name for themselves is *Innuit.* It means "men" or "people."

Eskimos learn readily and show marked intelligence in imitating the ways of the white man. They are cheerful and merry, fond of music, and friendly to strangers. They have learned the custom of handshaking from the white man, and they consider a handshake a sign of long friendship. Among themselves, Eskimos usually rub noses to show affection. They take good care of the aged and the children, especially the boys, who grow up to be the family heads and the chief food providers.

Their villages are small, with from 25 to 200 inhabitants. Eskimos have no tribal chief and no form of government. Sometimes all the people of one tribe will be found living in a community igloo. Food and shelter are considered the property of the group. Only articles obtained from the white man are looked upon as personal possessions, and even these items are usually shared with the less prosperous. Warfare and stealing are almost unknown to them. An undesirable character is punished only with the unanimous consent of the tribe or group. Such penalties are usually administered by the nearest of kin to avoid future blood feuds between families.

Eskimo Language and Religion

Scientists believe that the Eskimo language is a distant branch of the Ural-Altaic tongue. The speech has a deep gutteral sound with an irregular rhythm. The Eskimo must have a vocabulary of about 10,000 words. Each word has its own exact meaning, and the word forms are changed (inflected) to fit their use in sentences.

For years their only form of written communication was picture writing. But about 1900 an Anglican missionary, Rev. E. J. Peck, introduced a system of writing somewhat like shorthand. Each symbol represented a syllable. A form of pidgin English, employing both Eskimo and English words, is spoken at many trading posts. But from missionaries and government schools more and more American Eskimos are learning the English language.

Through the efforts of missionaries many Eskimos in west Greenland, Labrador, and southern Alaska have adopted Christianity. But some isolated tribes still follow taboos dedicated to spirits that are supposed to rule all nature. These unwritten religious laws take many forms. Some tribes will not break a bone from a wolf. Others believe that if a woman eats eggs she will be unable to bear children. To help them observe the various taboos, many Eskimos wear a fish heart and bits of fur in a charm bag around their necks (*see* Magic). Religious rituals are conducted by a tribal medicine man or shaman, called an *angakok.* He recommends the best time for fishing and hunting, hears confessions of broken taboos, and cares for the sick and injured.

Early History of the Eskimo

Anthropologists believe that the Eskimos migrated from Siberia to North America by way of the Bering Strait and Aleutian Islands more than two thousand years ago. They gradually spread eastward until many tribes settled in Labrador and Greenland. A few, called "Caribou Eskimos" or Padlei ("away from the sea") located in the interior of Canada west of Hudson Bay. There they lived much like the Indians of the Great Plains. But most tribes hugged the treeless shores of the Arctic Ocean, for this body of water supplied most of the necessities of life—hunting grounds for seal and whale, fuel from driftwood washed up along its coast, and drinking water from fresh ice floes.

When the white man began to settle in the Arctic the Eskimos could contribute little to the new civilization. But they did give much-needed assistance to the early explorers. They served as guides, helped build shelters, and taught the whites how to kill seal and caribou. The most successful explorers, notably Stefansson and Peary, conquered the Arctic

THE END OF A SUCCESSFUL CHASE

This Eskimo hunting party is landing a dead polar bear on an ice floe in the Arctic Ocean near Alaska. The hunters pursued the bear in kayaks and killed it with bow and arrows. The sealskin bag attached to one of the arrows kept the bear afloat until the men could land it.

by "going native" and living off the land exactly as the Eskimos did

The Influence of the White Man

Scientists believe that at one time the Eskimos numbered almost 100 000 But the bleak shores of the Arctic Ocean could not sustain so large a population living under primitive conditions In years when game was scarce famine swept the land, killing thousands. Many others died from epidemics of measles, influenza, and smallpox

The steady decline in population ended only when the white man came to their aid The Canadian government and the United States Office of Indian Affairs in Alaska built hospitals and furnished nurses, doctors, and teachers Some tribes gave up their nomadic life to become pastoral people They lived off herds of reindeer provided by the government Others settled in villages that grew up around the early trading posts They became traders themselves, made trinkets for tourists, and hired out as laborers to their white neighbors Their children go to government schools, attend Christian churches, and wear clothes purchased at the trading post or village store Many now own radios and subscribe to newspapers

In Greenland too Eskimos have changed under the influence of Western civilization They have intermarried with Europeans until about half of them now possess some white blood They have learned to grow potatoes and other root crops during the short Arctic summer Many work in cryolite mines and others have become traders and storekeepers

Eskimos are essential to the development of the Arctic (*see* Arctic Regions) They are able to endure comfortably the rigors of the climate in the Far North Their age-old skill at fishing, hunting, and trapping provides fish products and valuable furs for world markets Eskimos also contribute a labor supply for working Arctic mines, building towns, and setting up weather stations and airfields

ATTENDING SCHOOL IN THE FAR NORTH

The nearest schoolhouse is hundreds of miles away, so these Eskimo children attend class in the home of a missionary near Hudson Bay The lesson on the blackboard is written in both the Eskimo and the English languages

ESPERANTO Many attempts have been made to invent a new universal language to serve the purpose that Latin served in the Middle Ages Volapuk, which was given to the world in 1879 by Johann Martin Schleyer, a German priest, attained a measure of success, but, when its triumph seemed assured, dissension arose among the leaders

Meanwhile however, Esperanto was developed and it soon outstripped all other artificial languages. It was the work of Dr Zamenhov, a Russian physician and scholar who presented it to the public in 1887 the name Esperanto coming from the Spanish for hope' It uses sounds and words common to all the European languages dropping what is special to any one of them The grammar is very simple, and many students have mastered Esperanto in a few months About 200 periodicals and some thousands of books have been printed in Esperanto Here is a stanza from a poem by its founder, with an English translation

Sur neutrala lingva fundamento	On a neutral lingual foundation
Komprenante unu la alian	Unde stand ng one another
La popoloj faros en konsento	The peoples shall form in agreement
Uno grandan rondon familian.	One great family circle

ESSAY It was in the tower of an old castle in France, in the year 1571 that the first 'essay was written Michel de Montaigne, a cultured French gentleman, had retired there to forget the cares of the busy world, and to read and meditate in quiet A desire to 'preserve his memories and 'clarify his reflections' led him to write He called the little book, which he began at this time and published in 1580, Essais —meaning *attempts* or '*trials*'

The term essay, which was soon adopted in England thus suggests that the author is merely touching upon the subject in hand, and not treating it exhaustively, *that he is giving* a short comment rather than a complete and formal discussion as in a 'treatise' or 'monograph "

"Myself am the groundwork of my book," said Montaigne, and indeed it is mainly the author's personality as he reveals it to us that makes a good essay

Unlike the novel or the short story or the drama, the essay does not aim primarily to create characters and through them to tell a story. It speaks directly to the reader, giving the author's views on customs or happenings or people, on art, on books, or on life in general. It may teach, argue, persuade, arouse emotion, or merely amuse. Its subject may be almost anything, from 'Easter Bonnets' to 'Grand Opera'.

Though French in origin, the essay form appealed especially to the English. After Montaigne, an Englishman, Lord Bacon, was the next great writer of essays. He called his essays "certain brief notes set down rather significantly than curiously" and spoke of them also as "dispersed meditations." As a matter of fact, his essays are very compact and written with painstaking care. They are somewhat more formal and less personal than those of Montaigne.

When magazines and newspapers began to be published, the essay became especially popular. In two periodicals, published in London in the beginning of the 18th century, called *The Tatler* and *The Spectator*, Addison and Steele wrote essays commenting on the life of the time, the most famous being the Roger de Coverley papers.

Then in the 19th century came one of the most delightful of essayists—Charles Lamb, who, though he hid under the pen name of "Elia," revealed his whimsical lovable personality as few writers have done. His humorous 'Dissertation on Roast Pig' and his tender and pathetic 'Dream Children' are inimitable. At about the same time Macaulay wrote essays of a very different type. They are very carefully organized and noted for the clearness of their style and the splendor of their diction. Macaulay's essays, that on Milton for example, may be taken as typical of the formal essay, as Lamb's 'Essays of Elia' are representative of the familiar or informal essay.

Of the essayists who followed, some leaned more toward one type and some toward the other, but each wrote in his own way. Hazlitt, Carlyle, Ruskin, Thackeray, Matthew Arnold, and Stevenson are among the greatest essayists in England. In America Washington Irving in his 'Sketch Book' and Oliver Wendell Holmes in his 'Autocrat of the Breakfast Table' used the essay form with great success, and Emerson's ethical essays became especially famous.

Today we meet a form of the essay every day in the editorials of the daily newspapers, while in our magazines the essay still occupies a prominent place and for some readers has a stronger appeal than the more exciting short story. (*See* Writing.)

ESSEN, GERMANY. In peace and in war, the city of Essen supplied Germany's demands for the products of iron and steel. Situated in the valley of the Ruhr River, which gives its name to northwest Germany's mighty industrial and mining region, it became in the 19th century the Ruhr's chief city.

From mines beneath Essen and from the Ruhr Valley all around came the coal that provided fuel for the city's many mills and factories. A canal gave the city access to the Rhine. Railways, air lines, and highways provided additional transportation.

A Benedictine abbess, Hedwig, established Essen in the 10th century. Until 1803, when it came under the control of Prussia, the town was governed by the religious order. During all these 800 years it remained small and little known.

Then, around 1810, Friedrich Krupp set up a forge in the town. With three workmen he began to make tools for craftsmen who lived nearby. Long before the end of the century, the Krupp works employed thousands and were known the world over. From them, and from other factories of Essen, came armaments, railway cars, engines, ship frames, and farm tools.

To house Essen's rapidly growing population, communities of homes for workers were built in the city and its suburbs. By the time of the second World War, it had become a major city. As Germany's chief arsenal, it was bombed repeatedly in the war. American forces took it in April 1945. The Krupp works, covering 20 square miles, were heavily damaged; but after the war they were largely restored to produce civilian goods. Population (1950 census), 605,411.

ESTATES-GENERAL. When Philip the Fair of France needed help in his struggle with the pope in 1302, he called together representatives of the nobles, of the clergy, and of the townsmen of France, the three estates or classes, in order to gain their aid. Although there were meetings of similar partial groups in the preceding ten years, this date may be taken as the first meeting of the Estates-General of France, which in the beginning corresponded roughly to the Parliament of England, not yet 50 years old.

The French monarchy was more firmly fixed in power by the unfailing succession of the Capetian line, and the Estates-General never gained the right to make laws as the English Parliament did. The three estates never fused and the lower or third estate always lacked that leadership from the upper classes which the lower clergy and barons gave the Commons in England. Neither was there in France that tradition and practice of local self-government which prevailed in England. During the Hundred Years' War (1337–1453) the Estates-General could frequently force the king to do as it wished by refusing him money to carry on the struggle, but it as often forfeited public respect by favoring civil strife or even by allying itself with the English invaders. Near the close of the war (1439) it granted a land tax, the *taille*, from which the nobles were exempted. This favored and powerful class no longer had a good reason, as did the barons of England, for allying themselves with the Commons, and there was therefore no opposition when the king chose to consider such grants perpetual. As a result the king became independent. He had plenty of revenue, he had a standing army, he dominated the clergy and dispensed favors to the nobles, and so had little need of the Estates-General. Successive kings and great ministers found its opposition to royal power increasingly easy to break.

For 175 years (1614–1789) the representatives of the three estates were not summoned to consider the affairs of the kingdom But in 1789 the treasury was empty, and Louis XVI was forced as a last resort to call this almost forgotten body together again When it met, May 5, 1789, the representatives of the third estate, equal in numbers to the other two, refused to vote according to the old method, each estate casting one vote They insisted on voting as individuals Led by the bolder spirits they declared themselves the National Assembly, and on June 20, 1789 they took the famous Tennis Court' oath not to disperse until they had given France a constitution This bold attitude showed clearly that a revolution was at hand (*See* French Revolution)

The name estates-general was not uncommon in medieval Europe In Spain there were four estates or classes in the assembly In Holland the name States-General is still applied to the legislative body of that kingdom It is composed of two houses the upper elected by the provincial assemblies and the lower chosen by the people

The JEWISH MAIDEN *who Became* QUEEN *of* PERSIA

ESTHER In a beautiful Bible story we are told how the mighty king Ahasuerus of Persia chose from among all the maidens in his kingdom the one he deemed fairest to be his queen This was a Jewish maiden named Esther, although the king knew not who were her people or her kindred Her father and mother were dead and she had been reared by her cousin Mordecai.

But shortly after Esther became queen, a great disaster threatened her people A haughty man named Haman had been raised to the highest office in the kingdom, and he demanded that all should bow down before him Mordecai refused to bow down and for this Haman hated him so that he wished to destroy not only Mordecai himself but all the Jews The king allowed Haman to do what was good in his own sight and the wicked officer issued a decree that on a certain day all the Jews, young and old, throughout the kingdom should be destroyed

When Mordecai heard the dreadful news he begged Esther to intercede with the king Esther dared not approach the king, for there was a Persian law that anyone who entered the presence of the king without being called must die unless the king showed mercy by holding out his golden scepter But at last thinking that she may have been raised to her high station for the very purpose of saving her people, she said, I will go in unto the king and if I perish, I perish."

Clad in her royal robes, Esther approached the king s inner court Ahasuerus, seated on his throne, was so moved at sight of her that he held out his golden scepter and bade her approach "What wilt thou Queen Esther?' he asked "What is thy request? It shall be given thee even to the half of the kingdom" Esther's only request was that he and Haman should come that day to a banquet that she had prepared for them When they were banqueting, the king again asked Esther if she had any request and she asked the king and Haman to come again tomorrow to the banquet, and then she would tell the king what she desired of him

Haman Has a Gallows Built

Haman was very much elated at being invited to feast with the king and queen But when he saw Mordecai, he was so filled with wrath, that he caused a gallows to be made on which to hang him

Now some time before this, Mordecai, as he sat at the palace gate, had chanced to overhear two of the royal chamberlains plotting against the king s life He told Esther and she warned the king Thus the king s life was saved and so it was written in the book of records The night before the second banquet, the king could not sleep, so he called his attendants to read to him from the records And they read how Mordecai the Jew had saved the king's life "What honor has been done to Mordecai for this?' asked the king "Nothing has been done for him," was the reply While they were speaking Haman came into the outer court He wished to ask the king to hang Mordecai on the gallows that he had prepared The king bade him come in and said to him, "What shall be done unto the man whom the king delighteth to honor?' Then Haman thought to himself, "I am the man whom the king wishes to honor," and he replied, 'Let the man whom the king delighteth to honor be arrayed in the royal apparel and the royal crown be set upon his head, and let him be placed on the king s own horse, and let one of the king s most noble princes lead him through the city and proclaim before him, 'Thus shall it be done to the man whom the king delighteth to honor'"

Haman is Hanged on His Own Gallows

Then said the king "Make haste and take the apparel as thou hast said, and do so even to Mordecai the Jew" And so Haman was forced to array the despised Jew in the king s robes and lead him through the city, proclaiming before him, "Thus shall it be done to the man whom the king delighteth to honor"

The next night when they were at the banquet, the king said to Esther as before, 'What is thy petition? and it shall be performed even unto the half of the kingdom" Then Queen Esther said, "If I have found favor in thy sight, O king spare my life and that of my people, for we are to be slain" "Who is he that dares to do this?' said the king And Esther answered, "Our enemy is the wicked Haman" The king arose in his wrath and went into the palace garden, and one of the servants showed him the gallows that Haman had built for Mordecai "Hang Haman thereon," commanded Ahasuerus And so they hanged Haman on the gallows that he had prepared for the execution of Mordecai.

Mordecai was raised to the highest office in the kingdom, and the day that was to have been one of sorrow for the Jews was made a day of joy and gladness. Its anniversary is still celebrated as the festival of Purim, and on this holiday the Book of Esther, which tells this story of oppression and deliverance, is read in the synagogues.

ESTONIA. Three small republics of the Soviet Union—Estonia, Latvia, and Lithuania—face the Baltic Sea. The smallest and northernmost of these Baltic states is Estonia. (For map, *see* Russia.) Its area, 17,400 square miles, includes two large islands off the coast that are of great strategic value because they control traffic lanes leading from the Baltic Sea to Leningrad, Russia's chief port.

Except in the southeast, where the land is hilly, the ground is flat, with many lakes, streams, and marshes. Dairying is a major industry. The chief crops are rye, wheat, oats, and barley. Forests are still abundant and furnish lumber for match, furniture, and paper industries, as well as wood for fuel. Tallinn, the capital and largest city, is a picturesque seaport. A railway connects Tallinn with Leningrad.

The Esths, or Estonians, are a blond people related to the Finns. Their language is much like Finnish, which is Mongolian and not European in its origins. Most of the people are Lutheran in religion.

Little is known of the early history of Estonia. The Danes held the north from 1219 until 1346, when they sold it to German landholders (the so-called "Balts," or "Baltic barons"), who already held the south. Later the land was divided between Sweden and Poland. Sweden ruled all of it for about a hundred years until 1721, when Charles XII lost it to Peter the Great of Russia.

Estonia won its freedom from Russia after the Bolshevik Revolution of 1917. In 1918 it became an independent republic. In 1940, during the second World War, Russian forces occupied the Baltic states and Estonia became the Estonian Soviet Socialist Republic. The next year the Germans drove out the Russians. During the German occupation, German-speaking peoples of the Baltic states—descendants of the "Baltic barons"—were deported to Poland.

The Russians returned in 1944 and began at once to enforce their "sovietization decrees" of 1940–41. Numerous arrests were made of people who were thought to be anti-Russian. Many were executed and thousands were deported to Russian labor camps. The peasant farms were brought into large socialist collectives and all industries were nationalized. Population (1947 est.), 1,000,000.

ETHER. The action of sulfuric acid on alcohol produces the light, volatile, and pungent liquid called ether, which is extensively used in industry as a solvent of fats and oils, and in medicine as an anesthetic (*see* Anesthetics).

ETHER AND SPACE. Of what does space consist? What can we say about the vast stretches through which the earth, the sun, and the most distant stars are moving? We may be tempted at first to reply that space is simply emptiness. That will not do, because in space things *happen.* Light, for example, travels across space; so do heat rays; so does the attraction of gravity. Yet to the human mind it long seemed impossible that any force could be transmitted through an absolute void.

Early in the history of modern science, the *ether theory* was formulated and quite generally accepted. Ether was thought of as a material which filled all space, even permeating the areas occupied by ordinary matter. It was assumed to possess a variety of properties to account for its supposed action.

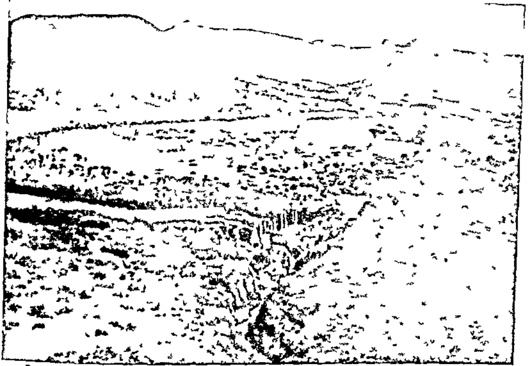
In 1887 experiments conducted by A. A. Michelson produced no direct evidence that an ether existed (*see* Michelson). Later, when Albert Einstein formulated his relativity theories without using the concept of ether, scientists generally discarded the term for the simpler "space" (*see* Relativity). In 1952, however, the British mathematical physicist P.A.M. Dirac published equations which many scientists agreed demonstrated the existence of ether. In his terms ether was a mathematical concept and not the material ether of older theory. (*See also* Atoms; Electrons; Light; Physics.)

ETHICS. Is a starving man entitled to take food that does not belong to him? Are we ever justified in telling a falsehood? Why do we classify certain actions as faults and others as virtues? These are all questions that belong to the field of "ethics," that branch of philosophy which deals with human actions from the moral point of view, as right or wrong, good or bad. Its field is character and conduct and the moral judgments we pass upon them.

You might, perhaps, suppose that there is no difficulty in deciding between right and wrong; and there is a certain field in which custom or tradition furnishes an undisputed standard. We know that we should not go out and murder our neighbors or steal their property. The only moral problem that arises in such instances is the practical one, whether we will do what we know is right. There are cases, however, in which we do not know what we ought to do. Suppose a manufacturer wants to pay his laborers a living wage but finds himself in competition with other people who do not. If he raises his wages he goes into bankruptcy. What shall he do? In solving such problems ethics insists that we must act with reference to all the facts involved. We must see all the things that are worth while and act with reference to all these "values."

The term "ethics" is derived from a Greek word meaning "manners," "customs," or "habits," just as "morals" is derived from a Latin word with a similar meaning. Some philosophers—those of the naturalistic school—believe that our present ethical system is the outgrowth of very slow and unconscious alterations of these habits and traditions. Others, however, believe that standards are not truly ethical unless they are the result of reflection and conscious criticism of these habits and customs. (*See also* Philosophy.)

ETHIOPIA—AFRICA'S *Mountain* EMPIRE



Range after range of towering mountains sweep across the gaunt plateau of Ethiopia in the northeast corner of Africa This air view shows the fal s of the Blue Nile some 20 miles from its source in Lake Tana in west Ethiopia

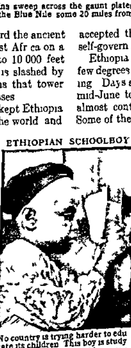
ETHIOPIA. Giant mountain walls guard the ancient land of Ethiopia It lies in northeast Afr ca on a plateau which soars from about 6 000 to 10 000 feet above sea level This rocky tableland is slashed by river gorges and ridged with mountains that tower from 12 000 to 15 000 feet with few passes

Until the 1930 s the mountain barrier kept Ethiopia almost entirely cut off from the rest of the world and the people lived much the same as their ancestors lived in ancient times The nobles kept slaves and warriors Rival lords and chieftains—carrying lances and rhinoceros hide shields and wearing headdresses of lion manes—fought each other in fierce feudal wars

Area Population Climate

Today Ethiopian leaders have opened their country to the world and are striving to bring better living to their people Ethiopia today is an empire built of several small old kingdoms With an area of some 350 000 square miles Ethiop a is about as large as Texas and Minnesota combined No census has been taken but an estimate in 1948 gives 10 079 200 as the total number of people In 1952 Ethiopians accepted the former Italian colony of Eritrea as a self-govern ng unit in federation with Ethiopia

ETHIOPIAN SCHOOLBOY



No country is trying harder to educate its children This boy is studying Amhar c the official language

Ethiopia is so high that although it lies only a few degrees north of the equator its climate is refreshing Days are sunny except in the rainy season from mid-June to the last of September Then ra n falls almost continuously from 40 to 50 inches a year Some of the rivers roar in flash flood

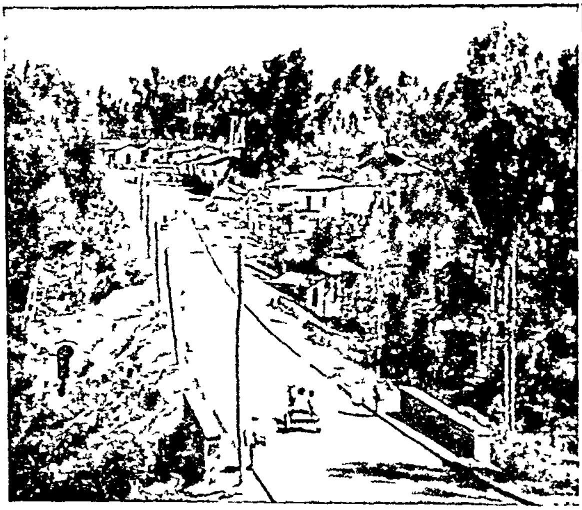
This rugged land of h ghlands is almost entirely a country of herding and small farming In the sem arid eastern and southern parts of Eth opia the people are nomad c and dependent ch efly on their cattle goats sheep and camels In the higher and better watered sect ons peasant farmers cultivate from about 50 to 75 per cent of the land They grow tobacco wheat corn barley sorghum fru t cotton coffee and some rubber and sugar cane

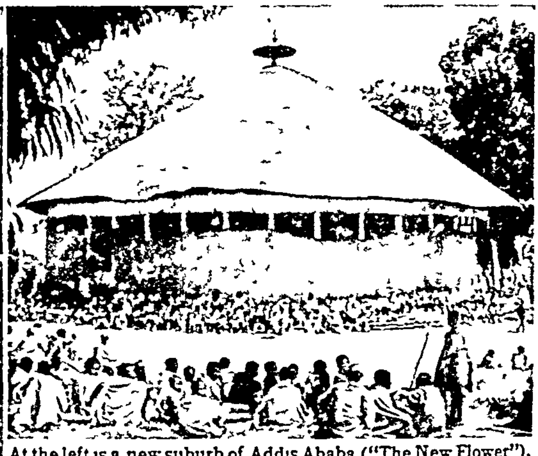
The Mixture of People

The emperor of Ethiopia claims descent from Solomon and the Queen of Sheba He bears the titles of Lion of Judah and King of Kings

The true Ethiopians numbering less than a third of the population live

CITY DWELLERS AND WORSHIPERS AT A COPTIC CHURCH



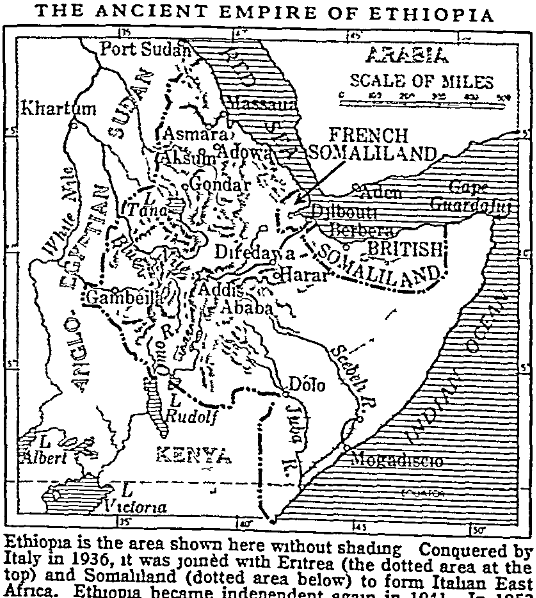


At the left is a new suburb of Addis Ababa ("The New Flower"), capital of Ethiopia. The city is about 8,500 feet above sea level and is built on hills. At the right is a typical village church, built in the same style as the native huts.

in northern and central Ethiopia—in the provinces of Tigré, Amhara, Gojjam, and part of Shoa Proud, strong, and dark-brown in color, they are simple and well-mannered people. They are Christians, members of the Coptic church, or Church of Alexandria. They are of Hamitic origin, with a strain of Semitic and often Negro blood.

More than one half the people are Gallas, a Hamitic pastoral group which is part Christian, part Moslem, and part pagan. The rest are Somalis, Falashas of Jewish faith, Negroes, and a few Greeks and Armenians. The official language is Amharic, an old Semitic tongue; but some 70 different dialects are spoken. The clergy, which generally is not well-educated, includes about one fifth of Ethiopia's men; and the church owns about a third of the land.

THE ANCIENT EMPIRE OF ETHIOPIA



Ethiopia is the area shown here without shading Conquered by Italy in 1936, it was joined with Eritrea (the dotted area at the top) and Somaliland (dotted area below) to form Italian East Africa. Ethiopia became independent again in 1941. In 1952 Eritrea joined it as a self-governing unit in federation with Ethiopia. This gave Ethiopia the seaport of Massaua.

How the People Live

Most Ethiopians are still very primitive people—either nomads or villagers. In the farming villages, which lie many miles apart, the people live in circular thatched huts made of mud because wood is scarce on the plateaus. Very few live in the valleys, where malaria is rife. At ceremonial feasts they gorge themselves with raw beef, but their daily food is bread, various cereals, butter, and a peppery bean mixture, washed down with beer or with a drink made from honey. A grass called teff gives a fine seed, which they grind between stones and make into cakes like buckwheat cakes. Their religion forbids them to eat pork. Salt is so scarce that some people use bars of it for small change.

Most Ethiopian fields are five acres or less; but the soil is so fertile that only a few hours' work a day produces two or three crops a year. Farmers merely scratch the humus-laden soil with a tree-crotch hoe or loosen the ground with a light surface plow drawn by hump-backed oxen. By not turning the soil, they conserve moisture for the dry season.

By western standards, their farming is primitive; yet no one goes hungry. Ethiopians live far better than most natives of the Red Sea countries. Farm experts from the United Nations, invited to advise Ethiopia, stated that it has the greatest possibilities in all the Near East for agricultural development.

Transportation and Communication

Ethiopia's greatest problem is transportation. The mountains make railroad construction so hard that only one line serves Ethiopia today. It is the French-owned narrow-gauge, 486-mile railroad from Addis Ababa to Djibouti in French Somaliland. When the Italians conquered Ethiopia in 1936, they built some truck highways. Most "roads," however, were twisting rocky trails that could be traveled only by mules, camels, or porters. In 1951 the International Bank

of Reconstruction and Development granted aid to the country to build roads and to improve air fields.

The mule and airplane are major means of transport. Planes touch market centers to pick up farm and herd products and link the nation with other lands.

Ethiopia's rivers have little transportation value. Many lie in steep canyons; others shrink in the dry season. The chief river is the Blue Nile, which flows from Lake Tana in the northwestern mountains.

Telephone lines and a radio network cover the country. In 1951 the International Bank granted aid to extend communication facilities.

Education and Industry

Early in the 20th century Ethiopia had less than ten schools. Now it has over 400, with teachers from Canada, United States, Britain and other nations. These also train native teachers. Children first learn to *read and write Amharic, the official tongue, and study* spoken English. Later they learn written English. The first university opened in 1951 in Addis Ababa. Many Ethiopians, aided by the government, study abroad.

Few towns have over 5,000 people. The many little villages move often as the firewood in the area runs out. Addis Ababa, the capital and the largest city, has about 250,000 people. Its paved streets, modern public buildings and motion picture theaters show the European influence of the Italian conquest and, later, of the Western advisers. Children and young people from Ethiopia's 12 provinces gather in the stadium for national "rugger" and track meets. Other major cities are the ancient walled Harar, center of the caravan trade; the more progressive Diredawa; and Jimma; and Gambeila, a river town with steamship service to Khartum in the Sudan.

Manufactures are chiefly for local needs. They include flour, tobacco, beer, glass, soap and leather. The major imports are salt, sugar, textiles, machinery and fuel. The chief export is coffee. Other major exports are hides, oils, wheat, civet and sheep, goat and leopard skins. The government is expanding the placer mining of gold, which it exports. Ethiopians also mine some platinum, mica and rock salt. In 1949 the government gave a 50-year lease to an American firm to drill for petroleum.

History of Ethiopia

About the 16th century B.C. Ethiopia was conquered by Egypt but re-won freedom in the 11th century. About 730 B.C. the Ethiopians conquered Egypt but were driven out by the Assyrians in 671 B.C. Ethiopia *remained independent* despite Persian and Roman attacks.

In the 4th century A.D. they were converted to Christianity by St. Athanasius of Alexandria. The Moslem onslaught on Christians in the *7th century drove* the Ethiopians back into the isolation of their mountains for 800 years, forgotten by the world. The Moslems, scorning them as Christians, called them Abyssinians (*see* Abyssinia). When Portuguese explorers first made their way to Ethiopia in the 15th century they thought that it was the *kingdom of Prester John*, a legendary Christian king of fabulous wealth.

During the following centuries the Ethiopians long and successfully resisted pressure from European nations. In 1864 the unpopular and vain Ethiopian king *Theodore III imprisoned the British legation*. In 1868 British troops freed them by force.

From 1870 to 1885, during the reign of Ethiopia's strong and wise King Menelik II, Italy established its colony of Eritrea on the Red Sea. The Italians *tried to push inland into Ethiopia, but the Ethiopian* army disastrously defeated Italy's forces at Adowa in 1896. In the treaty of Addis Ababa, 1896, Italy had to recognize Ethiopia's independence.

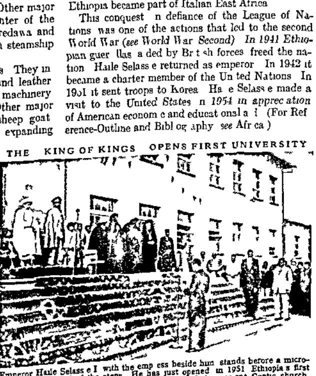
Guarantees Borders, Then Invades

*Meanwhile Britain and France had set up protector*ates on the Somali coast of East Africa. In 1906 the British and French joined Italy in an agreement to respect Ethiopia's borders. None of the three wanted the others to have an advantage in this region.

Only a generation later, in 1935, Italy broke the pact and invaded Ethiopia. The primitively armed Ethiopians could not beat back the savage armored attack of bombs and artillery. The Italian conquest was completed by the capture of Addis Ababa in 1936. Emperor *Haile Selassie I fled to England*. His protests to the League of Nations were futile, and Ethiopia became part of Italian East Africa.

This conquest in defiance of the League of Nations was one of the actions that led to the second World War (*see* World War, *Second*). *In 1941 Ethiopian guerrillas*, aided by British forces, freed the nation. Haile Selassie returned as emperor. In 1942 it became a charter member of the United Nations. In 1951 it sent troops to Korea. Haile Selassie made a visit to the United States in *1954 in appreciation* of American economic and educational aid. (For Reference-Outline and Bibliography *see* Africa.)

THE KING OF KINGS OPENS FIRST UNIVERSITY



Emperor Haile Selassie I, with the empress beside him, stands before a microphone at the head of the steps. He has just opened in 1951 Ethiopia's first university. At his left stand robed dignitaries of the ancient Coptic church.

The PURPOSE *and* PRACTISE *of* GOOD MANNERS

ETIQUETTE. The manners and customs observed by the influential people of a community or a region are spoken of as the *etiquette* of that place. This is a French word which meant first a label or ticket. The new meaning was added during the reign of Louis XIV, whose court functions became so elaborate that the master of ceremonies had to provide each guest with a ticket (*étiquette*) on which were noted the formalities expected of him. Proper behavior, then, was "according to the ticket." In this sense the word etiquette was adopted into English at the end of the 17th century.

Etiquette is necessary to enable people to get along pleasantly together. There must have been codes of manners among all prehistoric peoples who developed any sort of peaceful society. Primitive folk of today, such as Eskimos, Hottentots, and Bushmen, all have their rules of conduct and taboos. To violate one of these rules and taboos may be punished by expulsion from the tribe or by death.

Elaborate codes of manners seem to have originated in the Oriental countries. In China, at one period, there were 3,000 rules of conduct to be learned and obeyed. In ancient Japan a man could be put to death for a rudeness; and a rudeness was defined as a "not-to-be-expected thing."

Origin of Modern Formalities

Much of present-day etiquette has come from the courts which sprang up when tribes grew into kingdoms. Manners then were founded on reverence for the king. The knights who served the king were standard-bearers of courtesy. Many of their principles are in the gentleman's code today—for example, protection of women, refusal to take unfair advantage even of a rival, and care not to humiliate others.

Among the customs which started in those long ago days is the man's custom of removing his hat in the presence of a woman. It began as a gesture of respect and submission between men. The king's crown was the symbol of the supreme authority, and all lesser head coverings were in turn symbols of the rank and power of the wearer. The vassal bared his head in the presence of his liege lord, and even the great noble removed his petty crown when he paid homage to his king. Men of equal rank lifted their hats to one another as a gesture of friendship. After the rise of chivalry in the Middle Ages this mark of deference, respect, and peaceful intention was extended to all gentlewomen. Later when democracy began to level off distinctions of rank, men ceased to lift their hats to one another, but they continued to honor women in this way.

The handshake comes to us from the days when armed men approached one another warily. Extending the bare right hand with no weapon in it was an invitation to friendship and a pledge that no blow would be struck.

While these and many other old customs have been kept, others have changed as our ways of living and our attitudes have changed. The gentleman of the Middle Ages ate with knife and fingers—a shocking thing today, but forks were not introduced into northern Europe until the 17th century. The great 16th century scholar Erasmus wrote in a book of manners that it was girlish for boys to use powder on their teeth to whiten them, but that is not the opinion now. Two generations ago girls who were as athletic as many are today would have been thought hoydenish.

Foundations of Etiquette

In spite of such outward changes, the foundation stones of etiquette—kindness, fairness, self-control, gentleness, and self-respect—have in every age been the same. The important thing about good manners is that they make other people feel at ease. Since rules of etiquette are intended to make others comfortable, it comes about that the qualities which produce good manners help to make a person charming.

Kindness leads you to offer another the better seat, to listen to his opinions, and to avoid embarrassing him either by word or glance. Gentleness keeps you from talking roughly and doing offensive things, such as interrupting another while talking, or coughing in his face. Self-control prompts you to make your voice pleasant and pitched low; to walk without swinging your arms like pump handles; to stand erect, not slouched down on your heels with hands in pockets.

Self-Consciousness—Foe of Good Manners

Self-consciousness prevents many people from being charming. Lack of confidence makes them think constantly about themselves, because they are afraid they are not making a good impression. They feel that others are noticing and criticising them. They may timidly withdraw from conversation, or they may talk loudly trying to hide their timidity. But they are ill at ease and so others do not feel easy with them.

To overcome self-consciousness, take a greater interest in others; think of what may interest them; keep thinking of something in them you can admire; trust them enough to be friendly; remember that people want to like you and that most of them are kindly. Build up your self-respect; do something to earn it, if need be. Try to share what you have enjoyed and this will keep you from worrying about yourself.

Develop poise by practising self-control. Take time to think before you move or speak, and you will not make awkward blunders. When you catch yourself fidgeting and doing annoying things, such as tapping with a pencil, playing with table silver, or toying with something you are wearing, drop your hands in your lap. Relax your muscles, without slumping.

Since a knowledge of etiquette will give you more self-assurance, find out from books and from watching well-mannered people what is expected of you in various situations. But do not forget that charm depends on common sense. For example, a polite boy stands back to let a girl or some older person pass through a

door ahead of him But when he is near the door in a crowded elevator, he will step out quickly and get out of the way A boy rises whenever a girl or woman gets up from her chair or when she comes into the room, but it is not practical to observe this courtesy constantly in the schoolroom So too when a girl in her own house is serving refreshments it would be foolish for the young men present to rise whenever she leaves or enters the room

Two further suggestions for cultivating charm are learn to observe, and do not pretend to be something you are not Some persons do unpleasant things without knowing it, because they do not take the trouble to watch for the signs that show the feelings of others Those who try to make others think that they live in a grander way than they do, or who boast of fooling their teachers, earn the unpleasant name of 'show-offs." They are like the haughty Countess Gruffanuff in Thackeray's 'Rose and the Ring', who put on such airs that "all sensible people laughed at her absurd pretensions"

Manners at Home

Those with charming manners have acquired them by practising them every day in their homes Courtesy has become a pleasant habit, and such persons do not have to be uneasy about their manners in any company

First comes deference to the older people Well-bred young people rise and offer their mother the most comfortable chair when she enters the room, just as they would do to a visitor They help her with household chores They get the newspaper for their father They reply politely, "Yes, Mother," and "No, Father" not peevishly, "Wha-a-t?' or "Naw"

Respect for others' belongings is another courtesy first learned at home A boy has no right to take his brother's skates without permission, a girl is not fair if she grabs her sister's raincoat as she starts out, because she cannot find her own For reasons of hygiene as well as of etiquette, no one uses another's comb, brush, powder puff, or towels

Even with members of his own family, the courteous person will refrain from such liberties as opening another's bedroom door without knocking and waiting for a response, bursting noisily upon one who is reading or playing the piano or talking, or making a joke in company at the expense of a brother or sister

Sarcasm and cheap humor in the family circle are very bad manners Instead of saying "Thank you" a girl sometimes says to her brother who has shown her a special courtesy, "You must want me to do something for you" or "Are you sick?' Such remarks are not funny and discourage further thoughtfulness Family bickering is not heard in homes where tolerance, gentleness and self-control are cultivated

The dinner table is the center of family social life and provides a good training ground for learning etiquette Everyone should come punctually to meals. All should be neatly dressed—the men and boys with coats and collars on, the women and girls without hair curlers or aprons One of the boys should draw his mother's chair out for her If it becomes necessary to leave the table before all have finished, permission should always be asked of the head of the family Only pleasant subjects should be discussed—books, sports amusing incidents, news—and all should be given an opportunity to take some part in the conversation

In Street and Corridor

Well-bred persons in the street an auditorium or other public places, do not interfere with others' rights or draw attention to themselves Boys and girls who talk loudly and giggle in public push one another about noisily, or wear gaudy clothes are consciously or unconsciously trying to attract attention Such behavior is a sign of childishness and lack of experience

Other inconsiderate and rude kinds of behavior are these carelessly bumping into people swinging or carrying an umbrella so that it may hit someone else, strolling down the street in threes or fours so that others are forced out of the path, sprawling in the seat of a bus or street car, stretching the feet into the aisle for others to trip over squeezing in ahead of others in line at a ticket window, tossing trash into the street, park, or school yard, pell mell rushing or gathering in a knot in street or hallway

If two or more persons meet in street or corridor and wish to talk, they can walk together for a while or at least step to one side A boy will, of course, walk in the direction a girl is going

It is a girl s place to speak or bow first when she passes a boy she knows If the two are good friends and the girl has not happened to see him, the boy may greet the girl but never by calling loudly to her No one should call out a friend s name in a public place Nor is it polite for a boy to stand in front of a girl s house and whistle or sit and honk an automobile horn for her

When a boy is with a girl in the street, he walks on the side nearer the curb This custom goes back to days when there were no sidewalks and the cleanest and safest place to walk was as close to the buildings as possible If a boy is with two girls, he still belongs on the outside and not between them

These are some of the courtesies expected of a man or a boy He lifts (do not say 'tips) his hat when he speaks to a woman or she speaks to him, when someone with him greets a woman, when he meets or leaves a woman and when a woman with him speaks to a passerby He takes off his hat when he enters a room or a hotel or club elevator in which there are women He does not wear a hat in a house or school building He rises when a woman comes into a room or when she rises from her chair, and stands until she is seated He waits for a woman who is with him to enter a vehicle but he precedes her in stepping out so that he can extend his hand in helping her to alight He offers to carry a bundle or book for her, but a thoughtful girl will not allow him to carry her jacket or small girlish-looking packages.

A girl should give a gracious "Thank you" to one who offers her a seat, picks up her paper, or holds a door open for her. She will not expect a man of her acquaintance who happens to enter a street car or a bus with her to pay her fare, but if he does so, she will not protest against so small a favor.

In Theater and Restaurant

In assembly hall, church, theater, and other gathering places one should avoid unnecessarily passing in and out in front of people; arriving late and leaving early; laughing and talking during lecture, play, or concert; putting the feet on the seat in front; applauding at the wrong time or noisily or too long; rattling papers; tapping the feet or humming when there is music; crunching nuts or munching chocolates during a performance. A girl wearing a large hat must remove it for the sake of those behind her.

When a young man enters a restaurant or confectioner's shop with a girl and there is no waiter to conduct them to a table, the man leads the way, chooses a table, offers the girl the preferable seat, and pulls out her chair for her. If a waiter leads the way to the table, the man walks at the girl's side or just behind her. The man gives the order after consulting the girl. A thoughtful girl will consider her host's means in deciding what she will have but will not make him feel that she is stinting herself. The tip should be 10 to 15 per cent of the bill, or somewhat more if the service has been exceptional or much service has been required.

In Any Public Place

It is crude to address strangers as "Miss," "Lady," or "Mister." If it is necessary to use a title for someone whose name you do not know, say "Madam" or "Sir." It sounds more sincere to say "I'm sorry" if you inconvenience a person than to say pompously, as many do, "Pardon me." When you must pass in front of someone, say "Excuse me."

There are unsightly acts that no considerate person will perform in public. Gum chewing is one. The faces a chewer makes are not attractive; the sound of chewing is not pleasant; and the odor of gum is offensive to many. Spitting is both unsanitary and repulsive. In blowing the nose, the handkerchief should be used quietly and inconspicuously. Digging into the ears and clearing the throat loudly are as uncouth as scratching. Cleaning finger nails in public is no more excusable than brushing the teeth at a public fountain would be. These operations, like hair combing, are part of one's toilet and should be attended to in private. Girls should do their primping in bedroom or dressing room for the same reason.

How to Make Introductions

When you introduce two women or two men to each other, address the older one or the one in higher official position first. For example, speak to your teacher first in introducing a new pupil. "Miss Marks, this is Helen Fry." Address your school principal first in introducing your father—"Dr. Southern, my father"—unless your father is considerably older. When the two persons are of the same sex and about the same age, it does not matter whose name you give first. But in introducing a man and a woman or a boy and a girl, the woman or girl must be addressed first, unless the girl is very young and the man elderly or distinguished. Introducing two of your older sister's friends, you might say, "Miss Cape, do you know Mr. Mantle?" With your schoolmates, you would be less formal, "Freda Bay, Carl Hyde." You introduce a new school friend to your parents at the first opportunity. "Mother, I want to introduce Carol Dane to you" or "Father, this is Harold Hunt."

Many forms of introduction are used, but the names alone are sufficient if said graciously. Be sure to pronounce them distinctly. Commands like "Meet Miss Smith!" and "Shake hands with Bill Brown!" are not polite. "Let me make you acquainted with" is bad English and bad form. "May I present" is too pretentious for any except extremely formal introductions.

You may respond to an introduction with "How do you do," or "How do you do, Mrs. Brimm." Do not say "Pleased-to-meet-you." If you are introduced to someone you have heard about, you may say, if it is true, "I've wanted to meet you" or "Jack has told me about you."

Boys and men when introduced to each other rise and shake hands. When introduced to a girl, they rise, but they let the girl decide whether or not to shake hands. A girl need not rise when a boy or another girl is introduced to her. She does rise when she is introduced to an older woman or to anyone in her own home; also when a much older man is introduced or whenever the introducer is an older woman. A young girl will not take the lead in shaking hands when introduced to an older woman.

When an introducer adds a few words after an introduction, it is easier for two people to start a conversation. "Donald has just been transferred from Central High," "Eve skates as well as you do, Jack." Whoever thinks of something appropriate to say after an introduction may say it, but young people usually let older persons open the conversation.

When two persons have met and talked for a while, one may say upon leaving, "I am glad to have met you." The reply to such a compliment may be merely "Thank you," with a smile, or perhaps "I hope I'll see you again"—whatever seems natural.

Entertaining Guests

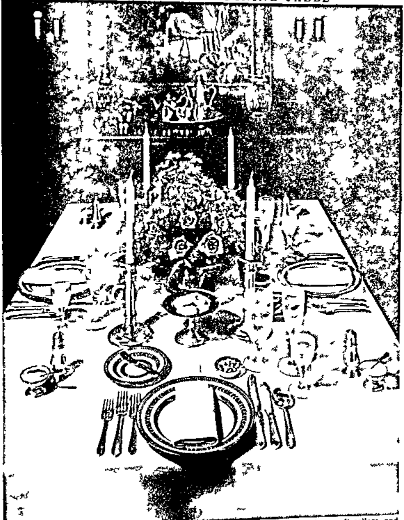
When you have guests, your wish is to give them pleasure and make them feel at home. You will see that they have comfortable seats and anything they may need; and you will lead the conversation to topics which are of interest to all. It is rude to talk with one guest about happenings the others know nothing about, so that they feel left out. Your mother, because she is the real hostess, will make a point of greeting your friends who come to the house, even though you may be going out with them at once. If your father is at home, he will like to speak to them, too.

Visits of several days made by younger high school

girls and boys to one another s homes are arranged by their mothers Older boys and girls may write an invitation in their mother s name for example Mother wishes me to invite you to spend Fourth of July week-end with us Can you come Friday afternoon and stay until Monday morning?

The young person who is expecting a visitor w ll not leave all the preparations to be made by his or her mother A girl will see that the guest room is ready—fresh linen on the bed a fresh scarf on the dressing table and hand towel bath towel and wash cloth la d out for the visitor The young host or hostess will see that the guest has an opportunity to do the things he or she likes to do and w ll not plan pastimes just for his own pleasure Most visitors especially enjoy the amusements they do not have at home

A WELL ARRANGED DINING TABLE



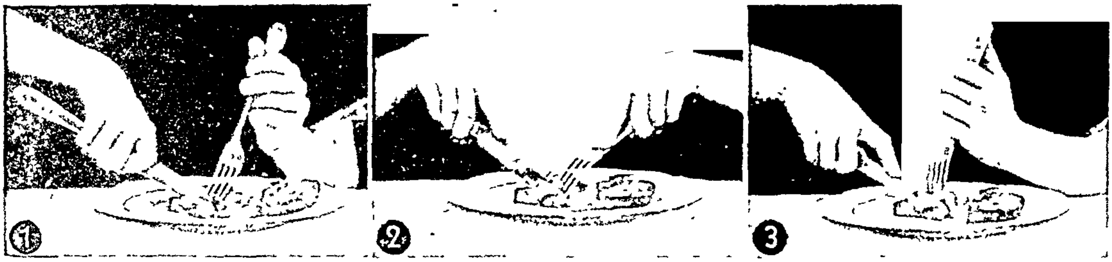
This photograph shows a comp ete y set tab e w th p ates s lve g asses napk ns salt cellars and peppe shake s in the r prope pos ons The fo ks a e arranged in the o de n whi h they wi be used Not ce the simp e and effect ve way the napk ns are fo ded But e p a e and bu e kn fe have been included here to show the prope p acement on the tab e a hough these wou d not be used for a s ctly formal d nne

Being a Guest

The visitor who goes calling should choose suitable hours and should leave before meal time approaches He should find out whether his stay is interfering with the plans habits or wishes of the family The house guest who will be invited again is the one who is prompt in coming to meals accepts the customs of the household cheerfully is polite to all members of the family does not forget to bring necessary to let articles helps when possible with household duties wi hout gett ng in the way does not urge son or daughter to do something against the parents wishes d es not use a towel for a shoe poli her or in any other way damage the belongings of the house makes as l ttle trouble as possible does not stay beyond the time set and does not go away leaving garments or art cles which will have to be forwarded later A girl takes care of her room if there are no servants or only one a boy does not leave clothes and shoes scattered around h s room

Guests may take a g ft to the r hostess or young friend or both though this is not the only way to show appreciation It does not look well to send a g ft immed ately after the vis t as if offering a payment for hospitality A gue t does not fail however to write a letter of appreciat on both to the hostess (the mother of the fam ly or whoever takes her place) and to the family member on whose account he or she was invited within a few days after returning home

RIGHT AND WRONG WAYS TO HOLD KNIFE AND FORK



1. This is wrong. The knife is gripped in the fist and the fork is held tines up with the fingers in the wrong position. 2. The correct way. 3. Children often hold knife and fork this way before their fingers are strong enough for the correct method.

This is called a "bread-and-butter letter." It may be brief, but not stilted or formal. It is well to recall some specially enjoyable feature of the visit.

Behavior at Dances

When a young man invites a girl to a dance, he dances the first and last dances with her and one or two more, at least. He introduces to her his friends, who, if they are polite, will then ask her to dance with them. He keeps an eye out for her to see that she is not left without partners and that she is not embarrassed by having to dance with one partner for too long a time.

When the cutting-in plan is followed, a boy goes up to a couple on the floor, touches the boy on the arm, and asks if he may cut in. He has, of course, been introduced to the girl, or a friend comes with him and introduces him. The girl's first partner thanks her for his dance, and she says, "I enjoyed it" or something else pleasant. He does not cut in again until she has another new partner.

A man never leaves a girl alone on the floor at the end of a dance. If someone else does not claim her, he takes her to a seat near friends or wherever she asks to be taken. If no one cuts in for a long time, the boy may make his partner more comfortable by stopping and introducing one of his friends to her.

When arriving at private parties, guests speak to the hostess as well as to the son or daughter or visitor for whom the entertainment is given; when leaving, they seek out the hostess and mention the pleasant time they have had. When chaperons act as hostesses at school parties, they are thanked for their part in the affair. Girls or boys who planned the entertainment pay the chaperons the courtesy of introducing their guests to them.

Boys and Girls

Friendships between boys and girls are jollier when both take care to learn what is fitting in social life. Young people should realize that a boy and girl who sit by themselves during a party, or dance together continuously are being rude to others in the group. Each should be too considerate of the other to urge any action that would bring family disapproval or would be an infraction of school rules.

When a boy pays a girl an attention, such as inviting her to a ball game or a dance, she does not thank him for the entertainment as if he had done her a favor, but she does let him know that she appreciates his courtesy. She may say when they part, "I have had a good time this afternoon," but her good spirits and interest have shown her enjoyment long before. When a girl is with a young man, she should let him take the lead in attending to arrangements and not be too quick to take matters into her own hands or do things for herself. If her escort does not know what courtesies are expected of him, she can often, without appearing to criticise, give him a suggestion; for example, "Will you hold my coat for me, please?" when she starts to put on her wrap.

A boy who wishes to give a girl a present will select something simple—candy, a book, a photograph album, flowers. It is in bad taste for him to offer presents or entertainment that he cannot afford, and a well-bred girl will discourage his doing so. She will prefer violets he has picked in the woods or a few garden flowers to extravagant purchases.

Games and Good Sportsmanship

Many believe that there is no better way of judging a person than by playing a game with him. The "poor sport" lacks both manners and character. Good sportsmanship calls for fair play; strict observance of the rules; acceptance of victory without crowing, and of defeat without ill humor. It is poor sportsmanship to make many excuses for losing; to try to rattle players on the opposing team by jibes; to put the blame for defeat on a partner; to accuse the referee of unfairness; to ask to be let off a penalty because "you didn't know it was against the rules." Politeness suggests that visitors be allowed first turn in a game; and boys give girls this privilege if the rules permit. In any game, one who unasked tries to teach others is usually unpopular. Those who let their animation become rowdiness are ill bred.

Setting the Table and Serving the Meal

A table is set with the knives and spoons on the right side of the service plate and the forks on the left, except the oyster fork, which is placed with the spoons. The piece of silver first needed is put farthest from the plate, and others in the order in which they will be used. The dessert silver is not put on the table until needed. The glass is at the head of the knives; the bread-and-butter plate at the head of the forks. The butter knife ("butter spreader" is not polite usage) is laid across the bread-and-butter plate

with the handle toward the user Napkins are laid on the service plates Candles in tall candlesticks may be set on the table when artificial light is needed Doilies and runners may be used for breakfast and luncheon but a tablecloth should always be laid for dinner

Properly the napkins are on the service plates at the start of the meal but when a hostess is doing her own serving she will have the first course —possibly grapefruit fruit or fish cocktail or soup—in its container on each service plate when the guests come in The napkins are then laid on the table beside the forks Service plates are never used after the soup course

Approved service today requires that dishes of food be kept off the table The meat already carved and the vegetables are handed around for each guest to help himself

The woman at the right of the host is served first hers being the place of honor Service proceeds around the table clockwise The practise of serving the hostess first so that she may see that the dish has been properly prepared is giving way to the politer custom of offering food first to a guest

As each used plate is removed at the end of a course a fresh one for the next course is put down. Plates for hot courses are heated The approved practise is to have only one plate removed or brought in at a time A tray is used only f r the sugar and cream served with coffee or berries

The hostess who has no maid can simplify service and still not clutter up her table with food or keep her guests busy passing dishes or commit the atrocities of stacking and scraping dishes at table She can have at her right a serving table and set the main course dishes on it after handing them (her daughter may do this) to have them near if she offers second helpings She may even serve the plates from this table Plates filled in the kitchen tea room style are not as appetizing as they might be Two dishes at a time may be removed when there is no servant and relishes may be set on the table Other short cuts which do not spoil the appearance of the table or seem slovenly may be employed such as putting the salad on the table with the main course

Whether a meal is elaborately served with butler and footman or served simply with no servant service should be quiet with no feeling of hurry The servantless hostess will plan to get up from the table

HANDLING SPOON AND CUP

1 The right way to hold a spoon 2 Three things are wrong here the spoon is held in the fist the right elbow is on the table and the left hand is holding the dish. 3 Correct way to hold a cup 4 This affected way of extending the fingers in handling spoon, fork, or cup is to be avo ded.

only a few times and will not attempt to entertain a large number for dinner

All dishes are offered and plates removed from the left side of the person who is being served Coffee cups are set down at the right and glasses refilled on that side A question of service can be decided by asking oneself what method will cause the diner the least inconvenience

Before the dessert course everything is removed from the table except glasses and nut dishes As each dinner plate is removed a dessert plate holding a doily a finger bowl half filled with water and a dessert spoon and fork is substituted The guest slips the doily and finger bowl onto the table near his plate He may put the dessert spoon and fork one on each side of his plate The dessert is then passed and each person helps himself If there is no maid the hostess sometimes serves the dessert plates at the table or the plates containing the dessert are served from the kitchen After dinner coffee in small cups may be served at table with or following dessert but a popular custom is for the hostess to pour it in the living room after the meal

Manners at Table

All rules for eating have reasons back of them which you can usually figure out for yourself For example when cutting meat we hold a fork loosely with the first finger pointing downward on the back of the handle instead of seizing it as if it were a pitchfork The knife is held in the same flexible way When you have cut a piece of meat you can sensibly take it to the mouth with the fork still in the left hand tines down This is the older American and European custom which is now rapidly returning Or you may lay your knife on the plate and transfer the fork to the right hand tines up before carrying the food to the mouth Do not be hasty and never cut more than one piece of meat at a time Whenever vegetables or foods not cut with a knife are eaten the fork is held in the right hand tines up When not in use knife and fork are laid side by side across the plate not propped against the edge possibly to slip to the table or drip grease on the cloth

The knife is used for cutting only Spoons are used for liquids cereals (dessert spoon) some desserts and a few other purposes but never for vegetables For these use a fork only But do not do any of the

following things with your fork: pile vegetables on the tines on top of a morsel of meat; take more food on it than you can eat at one bite; hold it filled with food on the way to your mouth while you talk; use it to make hills and valleys of your food.

Among the few foods that have to be eaten with fingers are olives, potato chips, burr artichokes, corn on the cob, and ordinary sandwiches; it is better, however, to cut sandwiches in halves before taking them in the hand. Peaches, apples, and similar fruits are pared, then cut into small pieces, and eaten with the fingers. After eating, one dips the fingers, of one hand at a time, in the finger bowl. Well-bred persons will not take up bones in the fingers except small ones of chickens or birds, and then only when the occasion is very informal.

Fruit pits are taken from the mouth in the cupped hand and dropped on the plate as unnoticeably as possible. Cooked fruit pits may be taken from the mouth with a spoon. A fish bone may be drawn from between the lips with the fingers. Rather than hide your face behind a napkin while you remove some tenacious object from your mouth, it is better to excuse yourself from the table for a few minutes. The white flag method makes a person unpleasantly conspicuous.

Bouillon is first sipped from the spoon, then drunk from the cup. Soup is drunk from the side of the spoon, and the spoon is dipped away from one to prevent dripping. Coffee, tea, or other beverages are not sipped from the spoon at any time. The coffee spoon is laid on the saucer, not left in the cup, possibly to be knocked over.

Other Details of Table Manners

When you sit down at the table, you immediately take up your napkin. Do not unfold a large one completely, but lay it across your knees folded once or twice, according to size. Lift only a corner to your mouth. If you are a guest, you need not refold your napkin at the end of the meal. Push it neatly under the edge of your plate as you get up, but not before. A used and crumpled napkin is not a pretty sight for those at the table.

Never butter a whole slice of bread and bite into it, leaving teeth marks. Break off a small piece, butter it, and then eat it. Other table practises to avoid are these: blowing on food or liquid to cool it; lolling with elbows on the table; saying rudely, "I don't like that," when a dish is offered. You can take a little of the food on your plate, even though you do not intend to eat it. If many dishes are served, you may refuse one with a "No, thank you," without fear of worrying your hostess. If you want a second helping and it is offered, do not hesitate to take it.

Perhaps the worst manners at table are eating with the mouth open, swallowing noisily, gulping water, and gobbling food in large mouthfuls. These actions suggest that the eater is thinking more about his appetite than about the company he is in.

If you are in doubt about what to do at the table, you can usually look around and see what others more experienced are doing. If you follow your own judgment as to what is natural, convenient, and unlikely to offend, you are not likely to go far wrong.

Some Principles of Dress

George Washington as a boy copied a set of "Rules of Civility" to guide his conduct. (Some of these are listed in the article on Washington.) They are just as sound today as when they were written. One of the rules about dress says: "In your Apparel be modest... Keep to the Fashion of your Equals such as are civil and orderly with respect to Times and Places." Shakespeare too had expressed the importance of this phase of etiquette when he had Polonius say, "The apparel oft proclaims the man."

Care about one's appearance shows a regard for others and a respect for oneself. And the assurance of being well-dressed gives self-confidence. Here are some of the things that well-bred people are most particular about: clean faces, finger nails, teeth, underwear, outerwear, and handkerchiefs; clean, neatly arranged hair; well-polished shoes; and unwrinkled stockings.

Dressing for dinner is a custom which has come about, because freshening the appearance tends to freshen the mind too and to put one in a more sociable mood. Even washing the hands and brushing the hair help, and no one should fail to do at least this much before coming to the table.

The first principle of being well dressed is to be suitably dressed—to consider, as Washington said, "times and places." A girl in a velvet or ruffly dress at school looks as much out of place as a boy in overalls would at a party. On a rainy day the well-dressed person wears clothes intended to stand the rain. A fancy hat does not go well with a tennis costume. Some noticeable inappropriatenesses are high-heeled sandals for walking or school; many pieces of jewelry; harshly colored ties; highly scented perfumes. Young girls should avoid conspicuous make-up, for their greatest charm lies in their freshness.

What to Do When Traveling

The good traveler goes his way quietly, does not put others out, does not make fun or complain of unfamiliar customs, and does not deface property with his initials or damage it to collect souvenirs. Only those with little knowledge of the world feel that they must talk with their seat mates in bus or train. If by chance an incident leads to conversation, the well-bred person does not allow it to become personal and is slow to suggest an exchange of names.

A young woman traveling alone will be very careful about encouraging any attentions on the part of a man, because her attitude may be misunderstood and lead to embarrassment for her. She will not let a man who happens to be thrown with her on a trip pay for her meal. She can say, "I think I'll dine later on," or "Thank you, but I'd rather pay my own check." It is a mistake in traveling to seek information from a stranger. Train conductors, station agents, and other authorized persons are the ones to consult.

A woman or girl spending the night in a sleeping car usually undresses in the berth before going to the dressing room in pajamas and robe or kimono. Some prefer to change in the dressing room if it is not crowded. It is important to stay in the dressing room only a short time, to take up as little room as possible with bag, clothes and toilet articles, and to leave basin and shelf tidy. It is best to take only a small case or, lacking that, to gather up your toilet necessaries in a towel or toilet kit.

When the Pullman porter offers to brush you off near the end of the trip he is usually given 50 cents for a night trip or 25 cents for a day trip. The fee for the redcap or station porter is set by the station. It ranges from 15 to 25 cents for each bag.

When traveling by air line the passenger has her ticket verified and her luggage weighed and checked at the airport terminal. She receives a boarding pass for the proper flight. Meals and snacks aboard are free of charge. Air line employees are not tipped.

Proper Procedure in a Hotel

As soon as people arriving at a hotel have made inquiries about a room, they register. A woman writes "Miss Eve Garden" or "Mrs I M Adam" since this is not a signature but an identification only. A man registers "I M Adam" or, if he is with his wife, "Mr and Mrs I M Adam." Many hotels now use individual registration cards. On these you write your street address as well as city and state, but in a desk register you omit the street and number unless they are required.

The bellboy who takes the baggage up to the room expects a minimum tip of 25 cents and more if there are several bags. For other services, such as delivering a package, he usually gets 10 or 15 cents. The fee for the chambermaid is left in the room. It may amount to a quarter a day or a dollar for a week. The card of rules in the room tells whom to call for special services and specifies the check-out hour. After this hour guests are charged for an extra day.

When ready to leave a hotel you may call a bellboy to take your bags to the door while you stop at the cashier's window to pay your bill. The tip to a cab driver for a short haul may be 15 cents, with 10 or 15 per cent added to a bill of a dollar or more. Customs in tipping vary from place to place. It is a sensible practice to inquire about them from friends when visiting a strange city.

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ETNA, MOUNT. Two hundred miles almost due south of Mount Vesuvius on the eastern coast of the island of Sicily towers the burning mountain of Etna. It is older than Vesuvius, much higher, and grander though less frequent in its eruptions. More than 80 eruptions of Etna are on record, the earliest about 479 B C. In 1169 A D 15,000 inhabitants of near-by Catania were destroyed, and again in 1669 some 20,000 perished. In the last hundred years there have been more than a dozen major eruptions. The great eruption of 1892 lasted six months. The eruption of 1928, while less violent than many others, caused an immense amount of damage.

In spite of these terrors villages and farmhouses nestle close on the broad expanse of Etna's flanks. The rich soil formed from old volcanic eruptions tempts people to take advantage of its fertility. The mountain rises through three zones. First comes the cultivated region to about 2,000 feet, where date-palms, bananas, oranges, lemons, olives, figs and almonds are grown. Next is a wooded region planted with forests of chestnut, cork, beech, pine, maple and oak. This contains a famous chestnut tree, one of the largest and oldest trees in the world, formed by seven trees grown together and 163 feet in circumference. At about 6,300 feet from the base of the mountain begins a dreary waste of black lava, ashes and sand, covered through a large part of the year with snow. A volcanic observatory 9,075 feet above the sea was built in 1880. This is the highest inhabited house in Europe, being 1,000 feet higher than the shelter on the Great St Bernard in the Alps. A fine highway leads from Catania up to the lava fields.

The summit of Mount Etna is about 10,750 feet above the sea, and its base is 90 miles in circumference. A considerable part of the world's supply of sulphur is gathered from the craters. The Sicilians call the mountain Mongibello, a corruption of the Saracen *Jebel Uttamat*, mountain of fire.

ETRUSCANS. Long before the days of Rome's greatness Italy was the home of a people far advanced in civilization and culture—the Etruscans or Tyrrhenians as they were called by the Greeks. This "riddle race" of Italy rose to prosperity and power and then vanished completely from the stage of history, leaving unsolved many problems concerning its origin and civilization.

The Etruscans taught Rome much of her art and science; they gave her many of her social, religious and political customs and institutions. Their blood mingled with that of the warlike Romans and still flows in the veins of the Italians of today. But their history is like a book that has been written and erased. Their literature has practically disappeared, the language of their inscriptions has been only partially deciphered, and only in the few remains of their

ancient buildings and monuments,—most of all in their tombs,—can we read their puzzling but fascinating story.

As we see them in the paintings on the walls of their tombs, the Etruscans were a short thickset people, fond of rich garments of graceful lines and bright colors. Their religion was somber and mysterious, and they dwelt much on the life after death; but they were fond of good living, games and amusements, dancing, music, and the theater. The women were noted for their rich jewelry; golden wreaths and coronets, brooches of delicate filigree work, long ear-rings, massive necklaces and bracelets, rings of beautiful design and many other articles of adornment, together with mirrors of polished bronze, have been found in their tombs.

Weapons and other implements, beautiful vases, and statues of stone, bronze, and terra cotta show that the Etruscans were skilled artisans. But they had little originality, most of their work being imitated from that of the Greeks.

It is thought that the Etruscans were a seafaring people from somewhere in or near Asia Minor. As early as 1000 B.C. we find them settled in Italy, between the Arno and the Tiber, in the district which corresponds roughly to modern Tuscany. At one time their rule embraced the greater part of Italy, including Rome. When the Tarquins were expelled from Rome, about 500 B.C., Lars Porsena of Clusium sought in vain to reëstablish the Etruscans.

Driven from Rome, the Etruscans sought power in other fields. They already controlled the commerce of the Tyrrhenian Sea on their western border, and now they strengthened their naval power by means of an alliance with Carthage against Greece. But in 474 B.C. their fleet was destroyed by the Syracusans, and from then on their power rapidly declined. The Gauls overran their country, and their strong southern fortress of Veii fell to Rome after a ten years' siege (396 B.C.).

EUCALYP'TUS. Next to the Douglas fir and the giant redwoods of the American West, the tallest tree in the world is *Eucalyptus regnans* of Australia. The largest one ever measured was 346 feet high. The tallest Douglas fir measured 380 feet, and the tallest redwood between 359 and 368 feet.

The eucalyptus is the dominant tree in Australia and has been widely planted in California (see Australia, section "Plants and Animals"). There are more than 350 species, ranging from forest giants to the small eucalyptus bushes so common in California. The trees shed their bark but keep their leaves.

THE GIANT TREE THAT GROWS FROM THE PIGMY SEED

The giant eucalyptus tree grows from a seed so tiny that several hundred would scarcely fill the palm of your hand. These marvelous little seeds mature within the tree's cuplike fruit, shown at the top of the picture on the left. Below you see the fruit, flowers, and leaves as they grow on the tree. The eucalyptus tree at the right is of the kind known as the "Red Gum."

Most species are valuable gum trees. The wood is tough and durable, and is much used for ship- and wharf-building because it resists decay in the water. It takes a high polish and so is valuable for interior finishing. Certain eucalyptus trees yield a gummy sap, from which tannin is obtained. The inner bark of some species consists of very tough long fiber, used for rope-making, paper, and thatch. The leaves, which in many species turn edgewise to the sun, furnish the eucalyptus oil (eucalyptol) used in medicine for its germ-killing and stimulating properties.

The name eucalyptus comes from two Greek words meaning "well covered," referring to the abundant foliage. Because this enormous leaf area enables them to evaporate into the atmosphere the vast quantities of water absorbed by their roots, eucalyptus trees are often planted in swamps, which they help to drain. It is this faculty for drying up mos-

quito marshes and not their sharp odor which has given them renown as a defense against malaria

The eucalyptus group belongs to the myrtle fam ly Among the most common species are the blue gum the manna gum the jarrah tree the peppermint tree an l the swamp mahogany The blue gum is the most im portant timber tree introduced into California It has been planted extensively in Texas to reclaim s vamps

The eucalyptus is best adapted to semitropical and warm temperate regions More than 70 species have been grown successfully in California an l tl e South we t where they are used for ornaments windbreaks build ng material and fuel Rows of them are planted along many of the roads and railroads

EUGENICS The science of eugenics has been widely defined as the study of possible ways to improve man s inherited qualities Eugenicists assume that certain types of individuals inherit socially desirable characteristics They propose to increase the number of such superior people and to decrease the number of those they call inferior ' In practise they concentrate upon controlling the feeble-minded the diseased and the criminal Methods generally advocated have been segregation birth control and sterilization

As early as the 6th century B C the idea of eu gen cs was expressed by the Greek poet Theognis The Spartans practised eugen c measures Plato suggested applying to mankind some of the methods used in breeding plants and animals Eugenics as a sc ence dates from 1883 when Sir Francis Galton coined the term The modern eugenics movement grew out of intensive research n hered ty (*See also* Hered ty)

EUPHRATES (*ū-fra tez*) **RIVER** The longest river of western Asia is the 1 700-mile Euphrates It rises in high mountains of eastern Turkey crosses eastern Syria and then flows southeastward through the entire length of Iraq In Iraq s hot dry climate it loses much of its water through evaporation and by diversion for irrigation It is navigable only by flat-bottomed river boats The Tigris its twin river to the east runs almost parallel with t F nally the two rivers merge in a swamp to form the Shatt-el Arab which flows into the Persian Gulf Both the Tigris and the Euphrates carry a heavy load of silt and have bu lt up a great alluvial plain The shore of the Gulf is today more than a hundred miles farther south than it was in ancient times

The land between the two rivers was an early center of civilizat on called Mesopotamia (*see* Babylon Babylon a and Assyria) In the 13th century its irri gat on system was destroyed by the Mongols and the rich plain aga n became desert and marsh In spite of some modern irrigat on orks its ancient fertility is not yet entirely recovered (*See* Iraq Tigris River)

EUROPE—*Mother Land of the* MODERN WORLD

Extent —North to south 2 400 miles f om Cape Nordkyn Norway 71°6 N latitude to Cape Ta ifa Spain at 36° N East-west about 3 000 miles from Cape da Roca Portugal 9°27 W longitude to 66°20′ E in the northern Ural Mountains Area estimated at about 3 900 000 square miles Population an estimated 547 000 000

Mounta ns —Northern system including mountains of Scotland and Scandinavia h ghest point 8 160 feet sou hern sys em in uding Pyrenees Alps and Carpathians, with Apennines and Ba kans as offshoots h ghest point Mont Blanc 15,781 feet Ural Mountains highest point 6 184 feet) and Caucasus Mountains (Mt Elbrus h ghest peak in Europe 18 481 feet) separate Europe f om Asia

R vers and Lakes —Chief rivers Rhine Elbe Oder Vistula Dvina and Pechora flowing northward into the North Sea Baltic or A ctic Ocean Rhone Po Danube Dniester Dnieper and Don flowing south into the Med terranean Adriat c o Black Seas Vo ga and Ural flowing south into the land ocked Caspian Sea La gest lakes Ladoga about as large as Lake Ontario Onega and Peipus in Russia with numerous smaller lakes in Sweden F nland and the Alpine region

EUROPE For more than 2 000 years the people of Europe led the world in achievement and influence Their accom plishments in science art literature politics and economics surpassed those on any other con tinent In the last four hundred years Europeans spread their cul ture over the world Nations founded by European colonists carried forward the standards and accomplishments of the motherland

The first half of the 20th century saw Europe rav aged by two bloody and destructive wars Its cities were blasted its factories shattered its capital spent its farm lands laid waste Its people suffered im poverishment hunger physical and mental wounds and torture Twenty million or more met death

All this devastat on has raised the question Can Europe come back? Can its peoples and nat ons regain the r former leadership or even stand as equals with the people of newer nations elsewhere?

Part of the answer may depend upon the measures taken by governments and perhaps upon the outcome of further wars But in the end Europe s future should arise just as d d its past from the nature of the continent and from the character of the people who built European civilization there

Europe is the second smallest continent Only Australia ranks below it With an est mated 3 900 000 square miles it is less than half the size of North America and less than a quarter of As a s area It is really a peninsula jutt ng westward from As a The two are together known as Euras a

The name Europe is of As at c origin It is derived from a Semit c word ereb meaning evening or sunset Hence to the Semit c peoples of western Asia Europe was the land of the setting sun The term was first applied to ancient Thrace

The boundary between Europe and As a is indefinite In the east the zigzag line follows old Russian political divisions These follow roughly the crest of the Ural Mountains In the southeast the boundary follows Russia s front er south of the Caucasus Mountains Elsewhere seas form Europe s borders The Arctic Ocean flows on the north the Caspian Sea on the southeast the Mediterranean and Black seas on the south and the Atlantic Ocean on the west

Europe has compensat on for its small size in its extremely favo able world location It lies squarely in the middle of the earth s great land masses When a globe is tipped so the largest area of ocean stretches

on one side and the greatest area of land on the other, Europe is found at the heart of the land hemisphere.

Another favorable factor is its north-south location. The greater share of the continent lies in middle northern latitudes. These latitudes have proved most favorable to man and his works. They contain most of the largest populations and most of the leading nations of the past and present.

In this strategic location, Europe has ready communication with the rest of the world. Land routes reach western Asia. Africa is but a short distance across the Mediterranean; and the most densely populated part of North America lies directly across the Atlantic. Men have shortened the water routes to the Orient by cutting canals through the isthmuses of Suez and Panama. They have also linked Europe to other lands with air lines.

Favorable Shape of the Continent

A glance at the maps on later pages reveals that Europe is splendidly shaped to participate in world commerce. It protrudes into the surrounding seas like a slender, irregular triangle, tapering from Asia in the east to a tip in Portugal. Peninsulas sprawl into the seas and islands stud the waters. No other continent has so many deep indentations bringing the advantages of the ocean so near to every region. In the south, the Mediterranean and Black seas carry ocean traffic 2,500 miles inland. In the north, the North Sea and the Baltic also penetrate far inland.

Only in Russia in the broad eastern base of the continent is any spot 1,000 miles from the sea. Every part of western Europe lies within 300 miles of ocean travel. The long, indented coast line measures 20,000 miles if only the important indentations are counted, and 50,000 or 60,000 if every little bay, inlet, and cape is included.

The continent's long, indented coast line has many harbors in bays and river mouths where the people have built busy ports. Some of the most important seaports have been constructed well up the rivers. Here they are more sheltered than if they were on the coast and more convenient to inland industries. The river mouths, or estuaries, are wide and deep enough for ocean vessels. The deeply indented coast line has also helped many peoples to develop great fisheries.

Europe's Peninsulas and Islands

The largest peninsula is Scandinavia, hanging between the Baltic and the Atlantic like a giant mitten. Opposite it, small Denmark juts northward. In the southwest, the Iberian Peninsula, containing Spain and Portugal, separates the Atlantic from the Mediterranean. At the Cape of Gibraltar, it reaches within 15 miles of Africa. Into the Mediterranean hang the boot-shaped Italian Peninsula, and the Balkan Peninsula, tipped by many-fingered Greece and its islands.

Outside this coast line, but near enough to be counted part of the continent, are many groups of islands. The largest and most important are the British Isles in the northwest. The narrow English Channel and the North Sea separate them from the mainland, and for some 900 years have protected the British people from invasion. The islands also afford good harbors, tillable land, and mineral resources. Iceland, a large island of 40,000 square miles, 500 miles northwest of Scotland, is sometimes considered part of Europe.

Other important islands rise from the Mediterranean Sea, south of the continent. Among them are Sicily, Sardinia, Corsica, and the Balearic group in the western basin; and Cyprus, Rhodes, Crete, the Ionian Isles, and Malta in the east. These islands and peninsulas offered convenient stopping places when early Mediterranean sailors learned to navigate the seas.

Favorable Surface of the Continent

The map of heights and depths on a later page reveals that much of the continent's surface is lowland. Europe has a larger proportion of lowland than any other continent. Its chief mountain masses run generally east and west in the southern half of the continent. To the north of this mountain backbone, a plain slopes down to the coast of the Baltic and North seas.

Westerly winds from the Atlantic sweep freely eastward over this plain, carrying moisture far inland. Most of Europe is thus supplied with abundant rainfall and temperatures are moderated. Europe has none of the huge deserts found on other continents.

Originally a large part of the continent was covered with dense forests that supplied material to build ships and homes. Today most of the woods are gone; but they left a heritage of varied soils. All these advantages give Europe the greatest proportion of land fit for agriculture of any continent.

Mineral Resources and Water Power

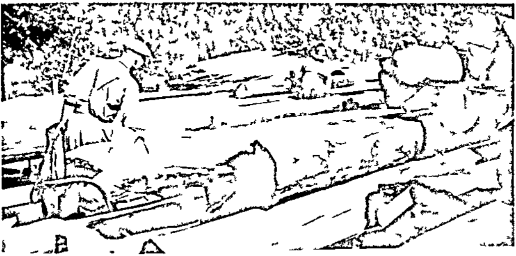
Beneath the surface, the continent has rich stores of minerals. The most important are generous supplies of coking coal and iron ore. Together they give Europe the means for building modern manufacturing industries. Building stone is abundant. Most other needed minerals exist in reasonable supply. The greatest lack is in petroleum. Only the eastern parts of the continent have productive oil fields.

The mountain streams offer sources of hydroelectric power, and many have been harnessed—particularly in the Scandinavian highlands, the Alps, and in Italy. This source of power is especially valuable in countries where coal is scarce. After the second World War, France undertook a huge dam and power plant construction program on the Rhone, designed to double French electric output.

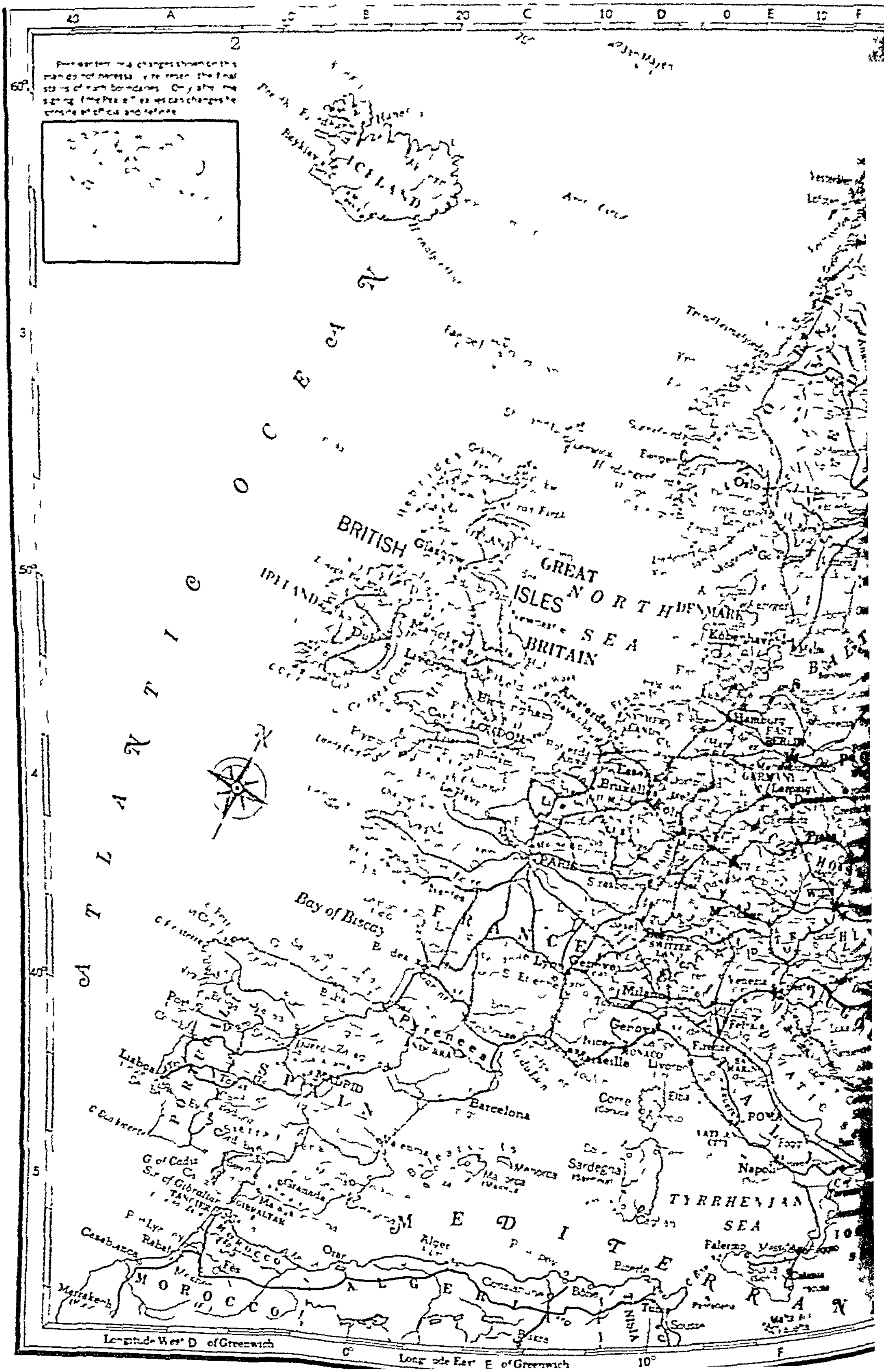
Europe's Rivers and Inland Waterways

This well-watered continent is drained by a network of rivers. Many are navigable for long distances; and through the centuries, the people have improved their natural waterways. They have dug canals around nonnavigable sections of the streams and have connected various rivers to create extensive waterway systems.

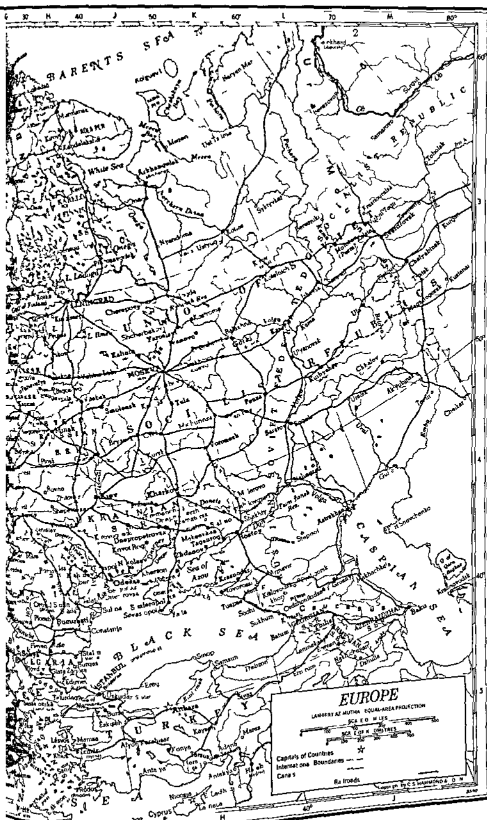
Europe's river-canal systems carry more valuable cargoes than those of other continents. The navigable rivers connect agricultural, mining, and industrial areas with one another and with the seaports. Their boats haul coal, ore, other raw materials, and foodstuffs to the industrial cities.



The top scene shows part of the g eat fo est that sp eads across northe n Eu ope Lumbering s a lead ng ndust y n th s rugged reg on wh ch s too cold for most crops The men a e saw ng logs w h a portable sawmill The bo tom p cture shows a erraced mounta n s de at Ravello Italy near the Gulf of Sale no Eu ope s Med erranean reg on s mounta nous and densely peopled Farmers cult vate every poss b e acre by terrac ng the slopes They grow g apes fruit, and ol ves

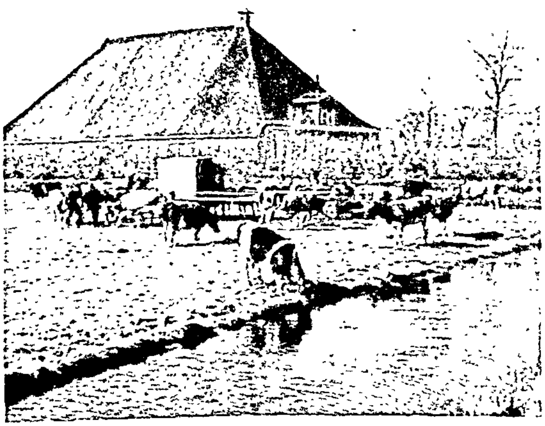


ICELAND
Reykjavik
ATLANTIC OCEAN
BRITISH ISLES
GREAT BRITAIN
IRELAND
Glasgow
Manchester
Dublin
LONDON
NORTH SEA
Bergen
Oslo
København
Amsterdam
Bruxelles
Hamburg
BERLIN
PARIS
Strasbourg
Bay of Biscay
FRANCE
Lyon
Genève
Pyrenees
SPAIN
MADRID
Lisboa
Barcelona
Marseille
Genova
Firenze
Venezia
ROMA
Napoli
Sardegna
Menorca
TYRRHENIAN SEA
MEDITERRANEAN
G. of Cadiz
Str. of Gibraltar
GIBRALTAR
Casablanca
Rabat
Fès
Marrakech
MOROCCO
Alger
Constantine
Palermo
Catania
Sousse
Biskra
Longitude West of Greenwich
Longitude East of Greenwich

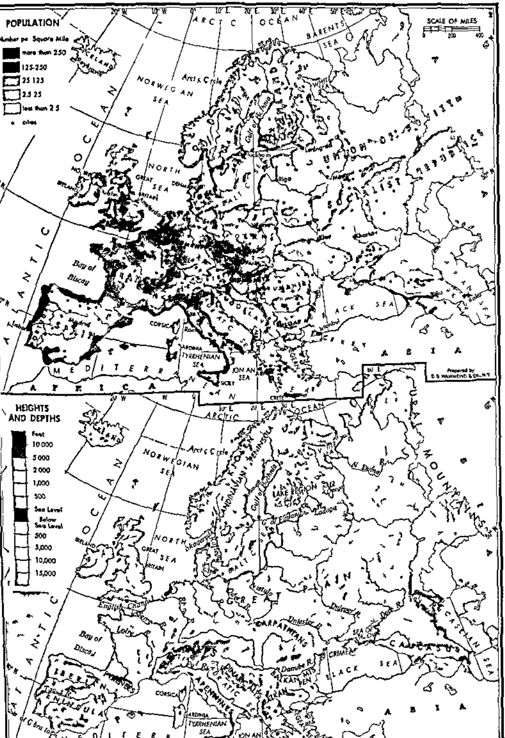


EUROPE
LAMBERT AZIMUTHAL EQUAL-AREA PROJECTION
Capitals of Countries
International Boundaries
Canals
Railroads
BARENTS SEA
White Sea
BLACK SEA
CASPIAN SEA
Sea of Azov
UNION OF SOVIET SOCIALIST REPUBLICS
LENINGRAD
MOSKVA
Arkhangelsk
Syktyvkar
Kotlas
Vologda
Cherepovets
Yaroslavl
Ivanovo
Gorki
Kazan
Kirov
Molotov (Perm)
Sverdlovsk
Chelyabinsk
Magnitogorsk
Ufa
Kuibyshev
Chkalov
Saratov
Penza
Ulyanovsk
Voronezh
Tula
Kursk
Kharkov
Kiev
Smolensk
Bryansk
Pinsk
Rovno
Dnepropetrovsk
Krivoi Rog
Zaporozhe
Odessa
Kherson
Makeevka
Taganrog
Zhdanov
Rostov
Stalingrad
Astrakhan
Krasnodar
Novorossisk
Tuapse
Sochi
Sukhum
Batum
Tbilisi
Baku
Makhachkala
Ordzhonikidze
Grozny
Voroshilovsk
Sevastopol
Constanta
Bucuresti
Ploesti
Burgas
Varna
ISTANBUL
Ankara
Samsun
Trabzon
Erzurum
Sivas
Kayseri
Konya
Adana
Antakya
Aleppo
Nicosia
Cyprus
Rodos
Izmir
Bursa
Eskisehir
Afyon Karahisar
Antalya
Sinop
Uskudar
Erevan
Tobolsk
Kurgan
Kustanai
Aktyubinsk
Emba
Uralsk
Guryev
Naryan Mar
Kolguev
Ob
Volga
Don
Ural

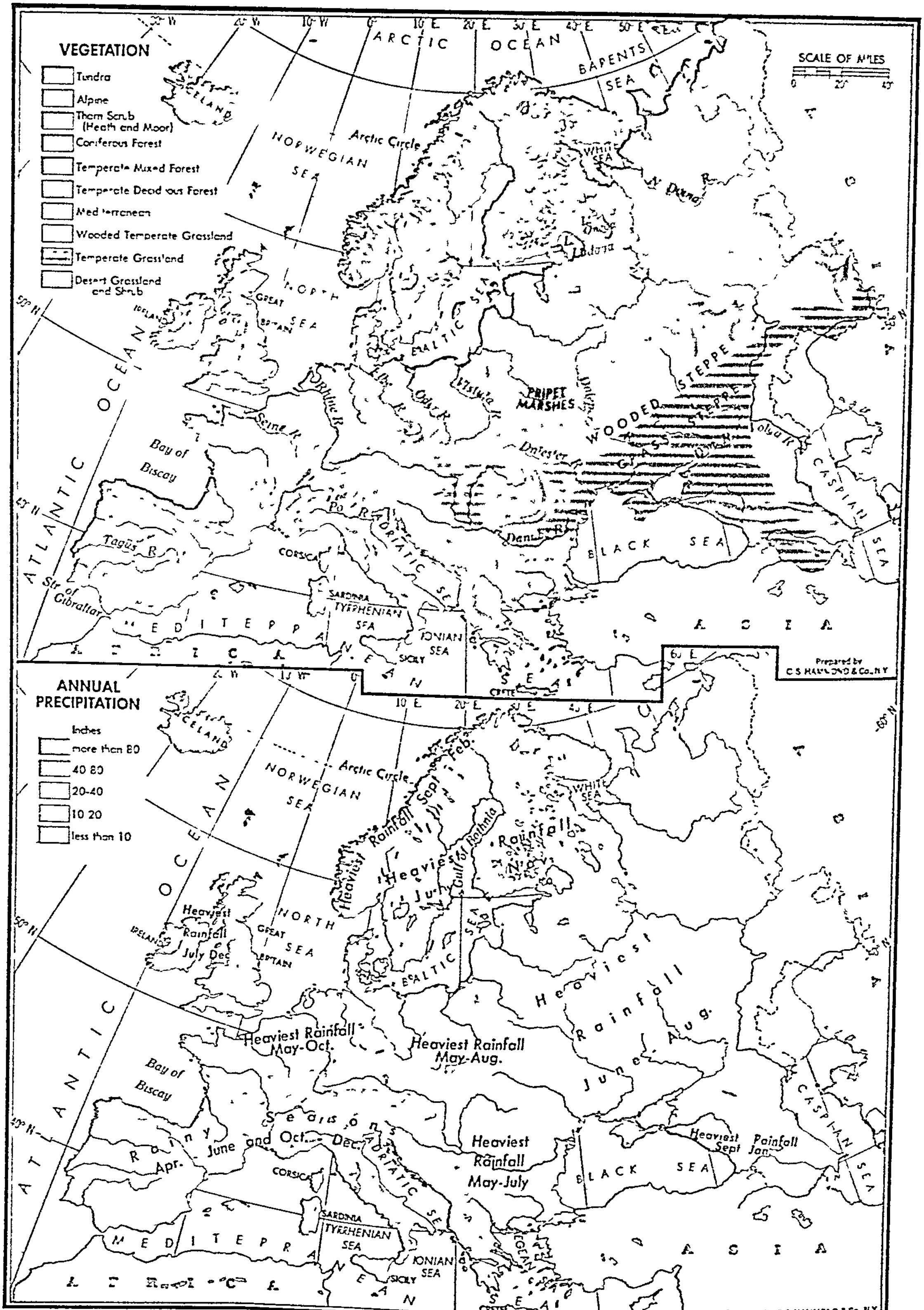
FROM LOFTY MONT BLANC TO A LOW DUTCH PASTURE



Here are contrasts in altitude and living in Europe. Mont Blanc (15,781 feet) in France is the highest peak in the Alps. Snow fields cover it and glaciers flow down its sides. Chamonix, at its foot, caters to summer and winter visitors. The dairy farm, at the left, lies below sea level in the thickly populated Netherlands. The Dutch build dikes and ditches to rid their land of water and make careful use of it. The farm building serves as home, cheese kitchen, hay mow, and winter stable. This farmer uses his milking machine in the field in summer.

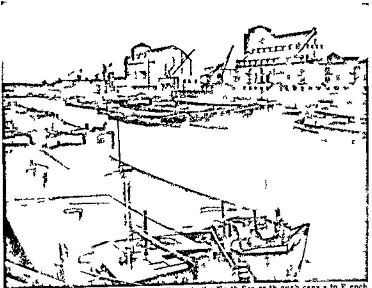


The top map shows how the people are distributed over Europe the most densely populated continent The physical map at the bottom reveals that the most thickly settled belt crosses the central plain from Wales to the Ukraine



The broad swath of blue on the bottom map shows that the Atlantic winds distribute abundant moisture across Europe, with the heaviest rainfall on high coasts and mountains. The top map shows the rich vegetation that grows in the moist climate.

THE BUSY PORT OF STRASBOURG IN FRANCE



These big barges carry freight down the Rhine to the North Sea or through canals to French and Belgian cities Rivers and canals are important in European transport

The Rhine system is the most important This river and its connecting waterways serve five leading industrial nations of western Europe and carry more freight than any other Other rivers flowing west or north from European industrial and commercial centers include the Seine the Weser the Elbe the Oder and the Vistula

In Russia the North Dvina and the Pechora empty into Arctic waters and are frozen many months each year The Dniester and the Don carry cargoes into the Black Sea Europe s longest river the Volga links central Russian industrial areas with the Caspian Sea

The Danube second river of Europe forms a highway between central and eastern Europe It carries much local traffic but little freight goes all the way to the Black Sea Nations along its route have set up political barriers to through traffic in recent decades

Rivers flowing into the Mediterranean are mainly short swift mountain streams The longest are the Ebro in Spain the Rhone in France and the Po in Italy Though the Rhone is not navigable the Saône Rhone valley has been an age-old land route

Development of Land Transportation

Though the waterways are important they are dwarfed by the railroads in mileage and in the amount of cargo they carry The network of railways and highways is denser in the industrial west than in the east The easiest area for land travel is the broad lowland or plain But European engineers have also threaded the mountains with roads and rails In most of the mountain systems natural valleys passes and depressions offer routes The Pyrenees between Spain and France and the Caucasus in the southeast raise the most difficult barriers Their passes are few and high but around the flanks of the ranges each has passages between the mountains and the sea

Military needs have influenced route locations throughout the continent European countries have always felt the need to defend frontiers and to move masses of men and munitions quickly

People Countries and National Barriers

Europe s energetic and progressive peoples have made good use of the continent s resources Not content with material achievement they have created great art have made outstanding advances in science and education and have sought greater political freedom and social justice

European progress has however been deterred by national rivalries customs barriers language differences and political beliefs and regulations For Europe is not a single country but many When European nations were being formed communications were not adequate to tie together so large an area Regions were cut off from their neighbors by barriers of mountain and sea There arose the patchwork of nations provinces and other divisions which appear on the political map

Many facts which help to explain the historic divisions between different peoples languages and nations are revealed by examining the physical structure the climate and the peoples of Europe

Physical Structure of Europe

ON A map Europe presents a complicated pattern of land deeply scalloped by seas that form many peninsulas But the heights and depths map on a previous page reveals a simple general pattern of high lands and lowlands

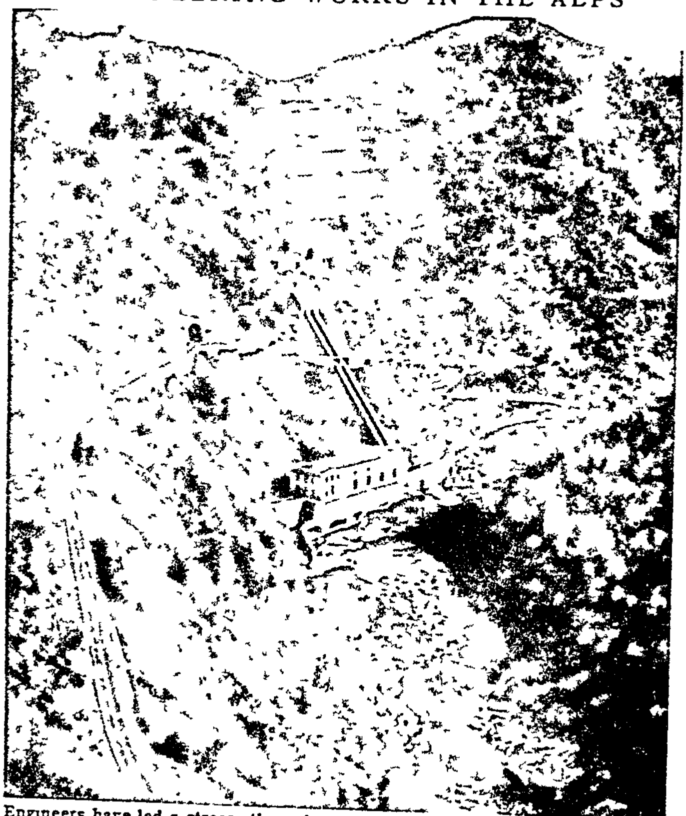
The lowlands form a rough triangle The base or southern side of the triangle runs from the west mouth of the English Channel to the Caspian Sea The eastern side of the triangle is a line running from the Caspian Sea to the Arctic Ocean skirting the Ural Mountains From the peak of the triangle the western side runs down to the English Channel

The greater part of these lowlands have resisted folding into mountains throughout geologic time The long irregular mountain ranges along the three sides of the triangle were formed when movements of the earth s crust forced rocks against the edges of the lowland mass and folded them

The Older Mountains of Europe

Throughout geologic time the process of mountain making went on Old ranges disappeared and new ones

ENGINEERING WORKS IN THE ALPS



Engineers have led a stream through a mountain to the penstocks of a hydroelectric plant. The railroad runs through a tunnel. A road follows the ridge where a terrace farm makes a firebreak in the forest.

were thrust up. The oldest European mountain system visible today rises in the northwest. It runs across the northern parts of Ireland, Wales, and England, across Scotland, and along the northwestern side of the Scandinavian Peninsula. Originally the system extended across the North Sea, but this part sank beneath the water. Geologists call these mountains the *Caledonian* system, from the Scottish (Caledonian) portion. They were formed originally in Silurian and early Devonian times (*see* Geology). Inside the Scandinavian portion is the broad, rock-based mass of land called the *Fenno-Scandian shield*.

The next oldest mountains lie along the southern edge of the lowland triangle. They were formed during the Coal Age, but only scattered parts of the original range remain. Geologists call these mountains the *Hercynian* system, from an ancient name for a German portion. They are also called the *Armorican Fold*, from an old name for the province of Brittany. They are now referred to as the central uplands. The uplands are found in southern Ireland, southern Wales, and Cornwall in England. France has remnants in Brittany, in its central plateau (the Cévennes) and in the Vosges to the east. Belgium and Germany have the Ardennes, and Germany has the Harz and the Schwarzwald (Black Forest) mountains. In Czechoslovakia are the Ore Mountains (Erzgebirge) and the Sudetens. Outlying remnants are found in the Meseta of Spain and in the Rhodope Mountains north of the Aegean.

After the Hercynian system was formed, the Urals were forced up against the eastern edge of the Russian plain. The plain itself is a vast resistant block called the *Russian platform*.

Lofty Younger Mountains of Europe

Generally south of the Hercynian system lies the youngest of Europe's mountains, the *Alpine* system. Its chief ranges are the Pyrenees, the Alps, the Apennines, the Dinaric Alps, the Carpathians, the Balkans, and the Caucasus. The Alpine system was created by an immense upheaval which acted as though Africa had moved north and forced rocks up from the sea bottom against the European continent. Most of the rocks were folded and pinched into lofty mountains, but a few areas resisted folding. Among them are the Hungarian and Rumanian plains

After the Alpine ranges were formed, a great Ice Age overwhelmed Europe (*see* Ice Age). Thick ice caps formed in the north and on the higher southern ranges. Erosion from moving ice cut down the higher peaks and gouged out deep valleys. Massive outwashes of water from edges of the ice left thick deposits of gravel, sand, and mud over the ice-free land Chill winds blowing out from the ice carried dust and piled up thick deposits of fine-grained loess soil beyond the edges of the ice.

The Climates of Europe

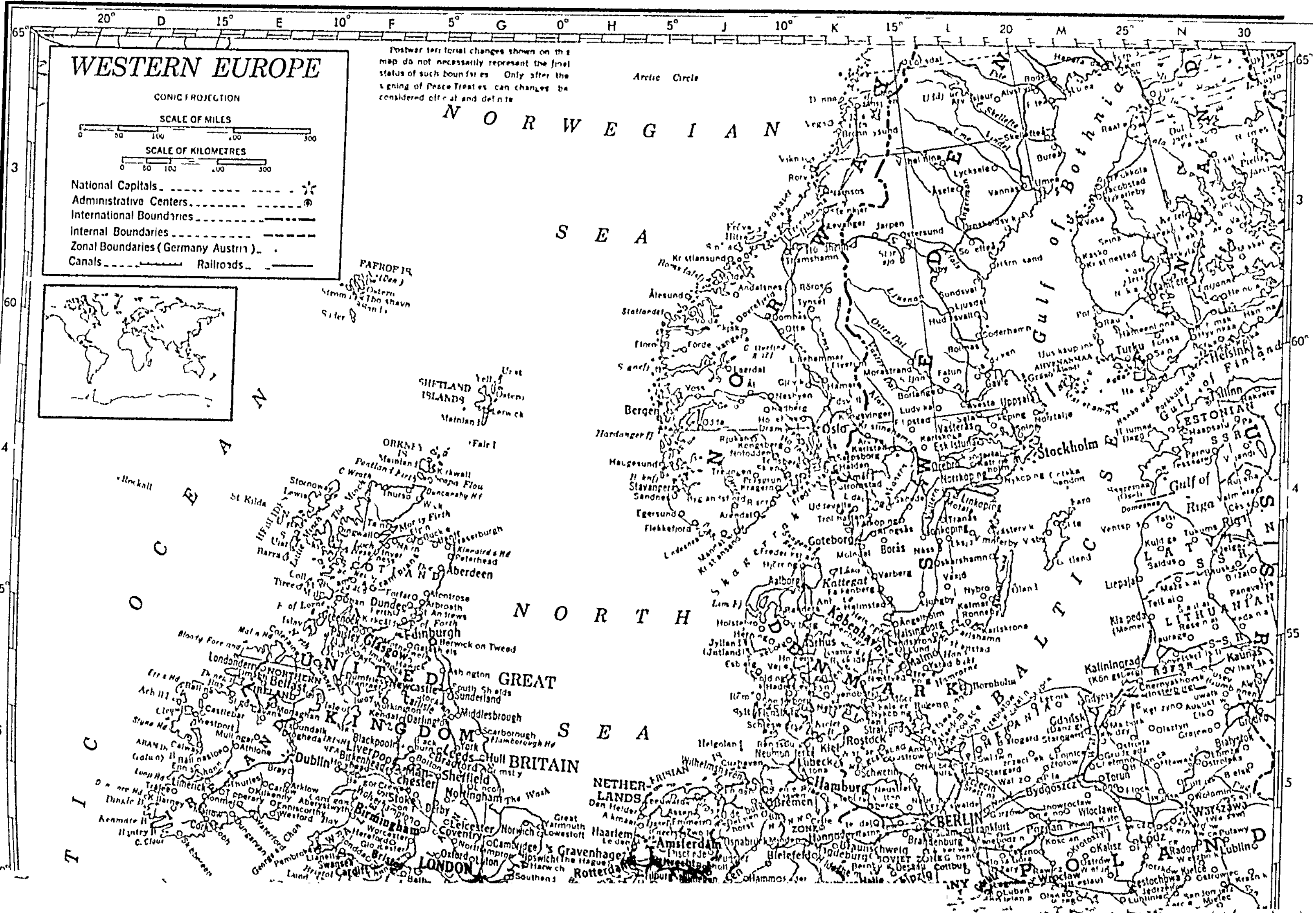
MOST of Europe enjoys a moderate and pleasant climate, generally favorable to human life and agriculture. The only unproductive land is in the more rugged portions of the mountain ranges, in patches of desert near the Caspian Sea, and a strip of cold tundra in the Far North.

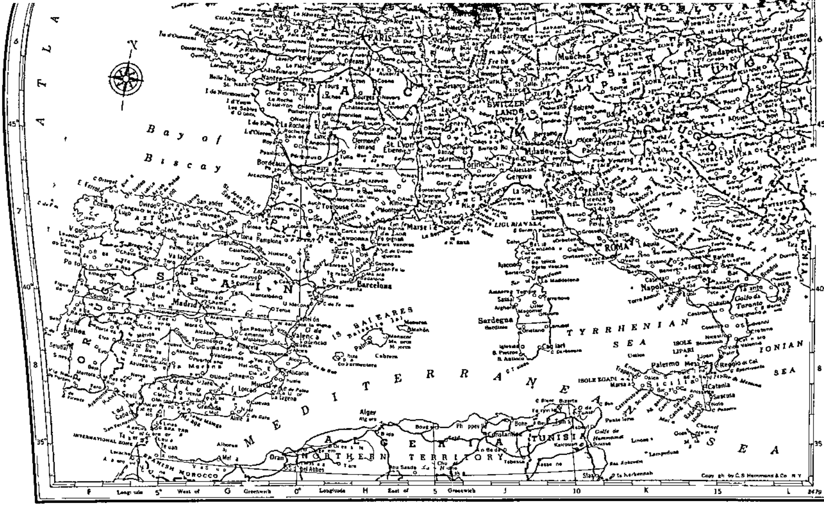
Western Europe's climate is called *marine*, because it is greatly influenced by the ocean. The Atlantic along European shores is warmed by drifts of warm water including the Gulf Stream. Therefore temperatures are usually milder than at the same distance north of the equator in North America. Mediterranean lands have climates comparable to that of the Pacific coast of California, although they lie 400 miles farther north. In northwestern Europe the contrast is even more favorable. The British Isles and the North Sea coast are about as far north as Labrador. But instead of having almost Arctic winters, these European localities have almost as high an average annual temperature as New York City, nearly 800 miles farther south. The difference between summer and winter temperatures also is less in western Europe.

WESTERN EUROPE*

Aachen, Ger	129 811	J 5
Aalborg Den	79 806	J 4
Aarhus Den	116 167	K 4
Abbeville Fr	18 008	H 5
Aberdeen Scot	182 714	G 4
Adrano, Sicily Italy	24 307	K 8
Agen Fr	26 051	H 7
Agrigento Sicily It	27 785	K 8
Aix-en-Provence Fr	53 076	J 7
Ajaccio Fr	27 536	J 7
Albacete Spain	†71 822	G 8
Albania	1 112 355	L 7
Albi Fr	27 185	H 7
Alcamo Sicily It	38 129	K 8
Alcázar de San Juan Spain	21 969	G 8
Alcira, Spain	21 059	H 8
Alcoy Spain	40 944	G 8
Alençon France	16 692	H 6
Alès France	20 027	H 7
Alessandria Italy	51 943	J 7
Alesund Norway	18 527	J 3
Algeciras Spain	20 810	F 8
Alicante Spain	†104 222	G 8
Alingsås Sweden	12 783	K 4
Alkmaar Neth	37 837	H 5
Allenstein (Olsztyn) Poland	29 053	M 5
Altona Ger		
Almadén Spain	12 643	G 8
Almendralejo Spain	19 361	F 8
Almeria, Spain	†76 497	G 8
Altamura, Italy	31 009	L 7
Altenburg Ger	51 805	K 5
Amiens France	79 807	H 6
Amsterdam (cap) Netherlands	803 847	J 5
Amstetten Aus	11 341	K 6
Ancona, Italy	57 100	K 7
Andorra	5 265	H 7
Andria Italy	54 438	L 7
Angers Fr	86 033	G 6
Angoulême France	39 987	H 6
Annecy France	24 414	J 6
Antequera Spain	21 891	G 8
Antibes France	13 778	J 7
Antwerpen (Anvers) Belgium	263 233	H 5
Anzio Italy	5 989	K 7
Aosta Italy	13 466	J 6
Arendal, Norway	11 751	J 4
Arezzo Italy	24 411	K 7
Argentan France	4 936	H 6
Arles France	20 138	J 7
Arlon (Aarlen) Belg	11 180	J 6
Arras France	30 065	H 5
Arvika Sweden	15 154	K 4
Aschaffenburg Ger	45 499	J 5
Ascoli Piceno It	20 665	K 7
Asti Italy	26 476	J 6
Athlone Ire	9 015	F 5
Aubusson France	4 935	H 6
Augsburg Ger	185 183	K 6
Aurillac France	18 957	H 7
Austria	6 903 905	K 6
Auxerre, France	20 809	H 6
Aveiro Port	13 421	F 7
Avellino Italy	20 578	L 7
Avezzano Italy	15 003	K 7
Avignon France	47 111	J 7
Ávila, Spain	†22 577	G 7
Avilés Spain	11 253	F 7
Avranches France	6 693	G 6
Ayamonte Spain	8 599	F 8
Ayr Scotland	43 011	G 4
Azuaga Spain	15 973	F 8
Bad Ischl Aus	13 441	K 6
Badajoz Spain	†79 291	F 8
Badalona Spain	37 809	H 7
Baden Austria	21 382	L 6
Baja Hung	28 416	L 6
Ballina Ireland	6 220	F 5
Ballinasloe, Ire	5 596	F 5
Bamberg Ger	76 180	K 6
Bangor, Wales	12 822	G 5
Banja Luka Yugo	37 770	L 7
Barcellona Sicily Italy	27 134	K 8
Barcelona Spain	†1 280 179	H 7
Bari Italy	267 726	L 7
Barletta Italy	51 597	L 7
Barnstaple Eng	16 302	G 5
Basel Switz	183 543	J 6
Bastia France	37 122	J 7
Bastogne Belg	4 863	J 5
Bath, England	79 275	G 5
Bayeux France	8 744	G 6
Bayonne France	28 110	G 7
Bayreuth Germany	58 800	K 6
Beauvais France	20 910	H 6
Bečej Yugo	23 394	L 6
Beja Port	14 059	F 8
Béjar Spain	10 609	F 7
Belfast No Ire	443 670	F 5
Belfort France	35 952	J 6
Belgium	8 512 195	H 5
Belgrade (Beograd) (cap) Yugo	469 988	M 7
Bellinzona Switz	12 060	J 6
Belluno Italy	10 083	K 6
Benevento Italy	26 692	L 7
Bergamo Italy	102 559	K 6
Bergen Nor	112 845	H 3
Bergerac France	17 014	H 7
Berlin (cap) E Ger	3 350 785	K 5
Bern (cap) Switz	146 499	J 6
Bernburg Ger	53 367	K 5
Berwick-on-Tweed Eng	12 550	G 4
Besançon Fr	51 939	J 6
Béziers Fr	59 834	H 7
Białystok Pol	65 460	M 5
Biarritz Fr	20 447	G 7
Biel Switz	49 342	J 6
Bielefeld Ger	153 613	J 5
Biella Italy	24 528	J 6
Bielsk Pol	15 491	M 5
Bijeljina Yugo	15 614	L 7
Bilbao Spain	†229 334	G 7
Birkenhead Eng	142 392	G 5
Birmingham Eng	1 112 340	G 5
Bisceglie Italy	32 5[illegible]2	L 7
Blackburn Eng	111 21[illegible]	G 5
Blackpool Eng	147 131	G 5
Blois Fr	21 606	H 6
Bocholt Ger	37 6[illegible]4	J 5
Boden Sweden	11 4[illegible]4	M 4
Bologna Italy	338 10[illegible]	K
Bolton Eng	167 162	G 5
Bolzano Italy	†63 805	K 6
Bonn (cap) W Ger	115 394	J 5
Borås Sweden	58 070	K 4
Bordeaux Fr	258 [illegible]	G 6
Borlänge Sweden	21 614	K 3
Bosnia Hercegovina Rep Yugo	2 843 486	L 7
Boulogne-sur-Mer Fr	34 380	H 5
Bourg-en-Bresse Fr	21 163	J 6
Bourges Fr	41 597	H 6
Bournemouth Eng	144 728	G 5
Bradford Eng	292 394	G 5
Braga Port	32 153	F 7
Bragança Port	8 245	F 7
Brandenburg Ger	70 632	K 5
Bratislava Czech	171 362	L 6
Braunschweig (Brunswick) Ger	223 760	K 5
Bray Ire	12 062	F 5
Breda Neth	85 294	H 5
Bremen Ger	444 549	J 5
Bremerhaven Ger	114 070	J 5
Brescia Italy	141 633	K 6
Breslau (Wrocław) Pol	341 419	L 5
Brest Fr	82 407	G 6
Briançon Fr	3 483	J 7
Brighton Eng	156 440	G 5
Brindisi Italy	35 984	L 7
Bristol Eng	442 291	G 5
Brive-la-Gaillarde Fr	30 000	H 6
Brno Czech	298 333	L 6
Bromberg (Bydgoszcz) Pol	159 836	L 5
Brugge (Bruges) Belg	52 748	H 5
Bruxelles (Brussel) (cap) Belg	184 838	J 5
Budapest (cap) Hung	1 058 288	L 6
Burgos Spain	†74 063	G 7
Bydgoszcz Pol	159 836	L 5
Bytom Pol	120 693	L 5
Čačak Yugo	18 050	M 7
Cáceres Spain	†45 429	F 8
Cádiz Spain	†100 249	F 8
Caen Fr	47 835	G 6
Cagliari Sardinia Italy	137 040	J 8
Calais Fr	41 536	H 5
Caldas da Rainha Port	10 039	F 8
Caltagirone Sicily Italy	31 028	K 8
Caltanissetta Sicily Italy	37 463	K 8
Cambrai Fr	24 580	H 5
Cambridge Eng	81 463	H 5
Campobasso Italy	17 043	L 7
Canicatti Sicily Italy	28 275	K 8
Cannes Fr	38 647	J 7
Canterbury Eng	27 778	H 5
Carcassonne Fr	31 752	H 7
Cardiff Wales	243 627	G 5
Carlisle Eng	67 894	G 5
Carrara Italy	25 2[illegible]	J 7
Cartagena Spain	†113 160	G 8
Caserta Italy	30 910	K 7
Casoria Italy	9 205	K 7
Castellón de la Plana Spain	†53 331	H 7
Castelo Branco Port	13 056	F 8
Castelvetrano Sicily Italy	25 000	K 8
Castres Fr	24 489	H 7
Castrovillari Italy	10 508	L 8
Catania Sicily Italy	297 773	L 8
Catanzaro Italy	27 907	L 8
Cegléd Hung	37 971	L 6
Cehegín Spain	8 129	G 8
Celje Yugo	25 435	K 6
Celle Ger	59 667	K 5
České Budějovice Czech	37 550	K 6
Český Těšín Czech	9 524	L 6
Cetinje Yugo	11 094	L 7
Chambéry Fr	26 641	J 6
Chartres Fr	23 509	H 6
Château Thierry Fr	7 283	H 6
Châteauroux Fr	31 195	H 6
Châtellerault Fr	19 216	H 6
Chaumont Fr	15 068	H 6
Cheb Czech	*32 264*	K 5
Chełmno Pol	11 634	L 5
Chemnitz Ger	250 188	K 5
Cherbourg Fr	34 034	G 6
Chernyakhovsk (Insterburg) U S S R	49 711	M 5
Chieti Italy	17 5[illegible]5	K 7
Chioggia Italy	23 5[illegible]	K 6
Chur Switz	19 382	J 6
Ciudad Real Spain	†34 244	G 8
Civitavecchia Italy	24 822	K 7
Clermont-Ferrand Fr	93 695	H 6
Cobh Ire	5 711	F 5
Coblenz (Koblenz) Ger	66 444	J 5
Coburg (Koburg) Ger	44 929	K
Cognac Fr	16 106	H 6
Coimbra Port	41 9[illegible]	F 7
Coleraine No Ire	10 748	F 4
Cologne (Köln) Ger	594 941	J 5
Como Italy	42 569	J 6
Compiègne Fr	15 530	H 6
Copenhagen (København) (cap) Den	768 105	K 4
Córdoba Spain	†165 403	G 8
Cork Ire	74 567	F 5
Corse (Corsica) (island) Fr	267 873	J 7
Cosenza Italy	30 038	L 8
Cottbus (Kottbus) Ger	49 131	K 5
Coventry Eng	258 211	G 5
Covilhã Port	20 423	F 7
Cracow (Kraków) Pol	347 517	M 6
Cremona Italy	54 564	K 6
Crewe Eng	52 415	G 5
Croatia Rep Yugo	3 913 753	L 6
Croydon Eng	249 592	H 5
Csongrád Hung	24 660	L 6
Cuneo Italy	18 802	J 7
Cuxhaven Ger	46 861	J 5
Czechoslovakia	12 339 674	L 6
Częstochowa Pol	118 919	L 5
Danzig (Gdańsk) Pol	191 051	L 5
Darlington Eng	84 861	G 5
Darmstadt Ger	94 788	J 6
Debrecen Hung	119 637	M 6
Delmenhorst Ger	57 273	J 5
Denmark	4 281 275	K 4
Derby Eng	141 264	G 5
Dessau Ger	88 139	K 5
Dieppe Fr	20 877	H 6
Dijon Fr	92 257	J 6
Dole Fr	16 340	J 6
Don Benito Spain	21 305	F 8
Dortmund Ger	507 349	J 5
Douai Fr	35 509	H 5
Douarnenez Fr	17 687	F 6
Dover Eng	35 217	H 5
Drammen Nor	27 297	J 4
Dresden Ger	467 966	K 5
Drogheda Ire	16 779	F 5
Dublin (cap) Ire	523 183	F 5
Dubrovnik (Ragusa) Yugo	19 063	L 7
Duero (river)		G 7
Duisburg Ger	410 783	J 5
Dumfries Scot	26 3[illegible]0	G 4
Dundalk Ire	19 678	F 5
Dundee Scot	177 833	G 4
Dunkerque Fr	9 369	H 5
Durres (Durazzo) Alb	14 031	L 7
Dusseldorf Ger	500 516	J 5
Eastbourne Eng	57 801	G 5
Eboli Italy	12 057	L 7
Ecija Spain	25 276	F 8
Edinburgh Scot	466 770	G 4
Eindhoven, Neth.	134 527	J 5
Eisenach Ger	51 834	K 5
Eksjö Sweden	9 752	L 4
El Ferrol del Caudillo Spain	34 777	F 7
Elbląg (Elbing) Pol	20 924	L 5
Elvas Port	10 421	F 8
Emden Ger	37 252	J 5
Emmen Neth	54 101	J 5
England	41 572 585	G 5
Enniscorthy Ire	5 949	F 5
Enschede Neth	101 015	J 5
Epernay Fr	18 716	H 6
Épinal Fr	21 939	J 6
Erfurt Ger	174 633	K 5
Esbjerg Den	48 205	J 4
Eskilstuna Sweden	53 577	L 4
Essen Ger	605 411	J 5
Esslingen Ger	70 633	J 6
Estonian S S R U S S R	1 000 000	M 4
Évora Port	25 678	F 8
Evreux Fr	16 645	H 6
Exeter Eng	75 479	G 5
Falaise Fr	3 954	G 6
Falköping Sweden	11 247	K 4
Falun Sweden	16 858	L 3
Faro Port	17 631	F 8
Fécamp Fr	16 07[illegible]	G 6
Ferrara Italy	134 181	K 7
Figueira da Foz Port	10 498	F 7
Figueras Spain	13 248	H 7
Finland	4 023 8[illegible]3	N 3
Firenze Italy	375 392	K 7
Fiume (Rijeka) Yugo	72 112	K 6
Flensburg Ger	102 832	J 5
Florence (Firenze) Italy	375 392	K 7
Foggia Italy	57 234	L 7
Folkestone Eng	45 200	H 5
Fontainebleau Fr	13 498	H 6
Forlì Italy	33 505	K 7
France	40 502 513	H 6
Frankfurt am Main Ger	532 037	J 5
Frankfurt Ger	51 57[illegible]	L 5
Frederikshavn Den	13 394	J 4
Fredrikstad Nor	14 326	K 4
Freiburg Ger	109 717	J 6
Fribourg Switz	29 005	J 6
Fulda Ger	42 213	K 5
Fürth Ger	99 83[illegible]	K 6
Galashiels Scot	12 496	G 4
Galway Ire	21 216	F 5
Gand (Gent) Belg	166 096	H 5
Gap, Fr	11 086	J 7
Gävle Sweden	48 894	L 3
Gdańsk (Danzig) Pol	191 051	L 5
Gdynia Pol	117 702	L 5
Gela Sicily Italy	31 918	K 8
Genève Switz	14 473	J 6
Genova Italy	678 200	J 7
Gent Belg	166 096	H 5
Gera Ger	89 212	K 5
Germany East	18 517 567	K 5
Germany West	49 732 824	J 5
Gerona Spain	†28 915	H 7
Gibraltar	23 232	G 8
Giessen Ger	48 712	J 5
Gijón Spain	†110 985	F 7
Glasgow Scot	1 089 555	G 4
Gliwice (Gleiwitz) Pol	128 203	L 5
Gloucester Eng	67 268	G 5
Gniezno (Gnesen) Pol	30 292	L 5
Gorizia Italy	30 265	K 6
Görlitz Ger	85 686	K 5
Göteborg Sweden	353 991	K 4
Gotha Ger	57 639	K 5
Göttingen Ger	78 680	K 5
Gottwaldov (Zlín) Czech	42 152	L 6
Granada Spain	†154 378	G 8
Granville Fr	9 937	G 6
's Gravenhage (The Hague) Neth	532 998	H 5
Graz Aus	226 453	L 6
Great Yarmouth Eng	51 105	H 5
Greenock Scot	76 299	F 4
Grenoble Fr	97 287	J 6
Grimsby Eng	*94 527*	H 5
Grodno (Gardinas) U S S R	60 000	M 5
Groningen Neth	13[illegible] 021	J 5
Grudziądz (Graudenz) Pol	38 80[illegible]	L 5
Guadalajara Spain	†19 131	G 7
Guarda Port	7 704	F 7
Guben Ger	25 297	K 5
Gusev (Gumbinnen) U S S R		M 5
Győr Hung	55 200	L 6
Haarlem, Neth	156 856	H 5
Hague The ('s Gravenhage) (cap) Neth	532 998	H 5
Halle Ger	222 505	K 5
Halmstad Sweden	45 278	K 4
Hälsingborg Sweden	71 718	K 4
Hamar Nor	11 507	K 3
Hamburg Ger	1 605 606	K 5
Hämeenlinna Fin.	22 36[illegible]	M 3
Hamm Ger	59 866	J 5
Hangö (Hanko) Fin	6 791	M 4
Hannover Ger	444 296	K 5
Harwich Eng	13 488	H 5
Hastings Eng	65 506	H 5
Haugesund Nor	*18 747*	H 4
Havre, Le Fr	105 491	G 6
Heidelberg Ger	116 488	J 6
Heilbronn Ger	64 643	J 6
Helder Den Neth	28 729	H 5
Helsingør Den	21 010	K 4
Helsinki (Helsingfors) *(cap), Fin*	363 834	N 3
Hereford Eng	32 490	G 5
Herning Den	19 439	J 4
Hildesheim Ger	72 292	J 5
Hindenburg (Zabrze) Pol	[illegible]82 888	L 5
Hjørring Den	14 033	J 4
Hódmezővásárhely Hung	59 340	M 6
Hof Ger	61 033	K 5

*All population figures are taken from the latest official census or estimate available. For date and source of a population *see* article on the appropriate country †Population includes suburbs


WESTERN EUROPE
CONIC PROJECTION
SCALE OF MILES
SCALE OF KILOMETRES
National Capitals
Administrative Centers
International Boundaries
Internal Boundaries
Zonal Boundaries (Germany Austria)
Canals
Railroads
Postwar territorial changes shown on this map do not necessarily represent the final status of such boundaries. Only after the signing of Peace Treaties can changes be considered official and definite.
Arctic Circle
NORWEGIAN SEA
NORTH SEA
ATLANTIC OCEAN
Gulf of Bothnia
Gulf of Finland
Gulf of Riga
BALTIC SEA
NORWAY
SWEDEN
FINLAND
DENMARK
GREAT BRITAIN
UNITED KINGDOM
NETHERLANDS
IRELAND
ESTONIAN S.S.R.
LITHUANIAN S.S.R.
POLAND
Oslo
Stockholm
Helsinki
København
London
Dublin
Amsterdam
Berlin
Warszawa
Edinburgh
Glasgow
Bergen
Göteborg
Hamburg
Bremen
Kaliningrad
SHETLAND ISLANDS
ORKNEY IS.
FAEROE IS.


Bay of Biscay
FRANCE
SPAIN
SWITZERLAND
HUNGARY
TYRRHENIAN SEA
IONIAN SEA
MEDITERRANEAN SEA
ALGERIA
NORTHERN TERRITORY
TUNISIA
SPANISH MOROCCO
INTERNATIONAL ZONE
IS BALEARES
Sardegna
Sicilia
PARIS
Madrid
ROMA
Barcelona
Marseille
Bordeaux
Toulouse
Napoli
Palermo
Budapest
Beograd
Lisboa
Alger
Oran
Genova
Livorno
Cagliari
Granada
Valencia
Zaragoza
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Longitude West of Greenwich
Longitude East of Greenwich
45°
40°
35°

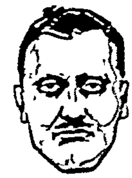
Holstebro, Den.	14,711	J 4
Holyhead, Wales	10,569	G 5
Honfleur, Fr.	7,783	H 6
Horsens, Den.	35,898	J 4
Horten, Nor.	11,418	J 4
Hospitalet, Spain	10,222	H 7
Hradec Králové, Czech.	52,292	L 5
Huelva, Spain	†63,648	F 8
Huesca, Spain	†21,332	G 7
Hull (Kingston-upon-Hull), Eng.	299,068	H 5
Hungary	9,204,799	L 6
Hyères, Fr.	15,020	J 7
Ibiza, Balearic Is., Spain	10,502	H 8
Iglesias, Sardinia, Italy	13,860	J 8
Imperia, Italy	20,916	J 7
Ingolstadt, Ger.	40,523	K 6
Innsbruck, Aus.	95,055	K 6
Inowrocław, Pol.	35,808	L 5
Inverness, Scot.	28,115	G 4
Ipswich, Eng.	104,788	H 5
Ireland	2,960,593	F 5
Irún, Spain	8,108	G 7
Issoudun, Fr.	11,189	H 6
Italy	47,020,536	K 7
Jaca, Spain	6,251	G 7
Jacobstad (Pietarsaari), Fin	12,400	M 3
Jaén, Spain	†61,610	G 8
Jászberény, Hung.	27,515	L 6
Jelenia Góra, Pol.	39,050	L 5
Jelgava (Yelgava), U.S.S.R.	34,099	M 4
Jena, Ger.	82,722	K 5
Jerez de la Frontera, Spain	†107,770	F 8
Jesenice, Yugo	15,811	K 6
Jihlava, Czech.	21,797	L 6
Jönköping, Sweden	44,685	K 4
Jyväskylä, Fin	24,050	M 3
Kaliningrad (Königsberg), U.S.S.R.	150,000	L 4
Kalisz, Pol.	55,146	L 5
Kalmar, Sweden	27,049	L 4
Kaposvár, Hung.	33,076	L 6
Karcag, Hung.	25,031	M 6
Karlovac, Yugo.	31,738	L 6
Karlovy Vary, Czech.	26,922	K 5
Karlshamn, Sweden	10,691	L 4
Karlskoga, Sweden	31,303	L 4
Karlskrona, Sweden	30,997	L 4
Karlsruhe, Ger.	198,840	J 6
Karlstad, Sweden	35,651	K 4
Kassel, Ger.	162,132	J 5
Katowice (Kattowitz), Pol.	170,036	L 5
Katrineholm, Sweden	14,492	L 4
Kaunas (Kovno), U.S.S.R.	105,370	M 5
Kecskemét, Hung.	88,374	L 6
Kemi, Fin.	23,524	N 2
Kempten, Ger.	39,821	K 6
Kiel, Ger.	254,449	K 5
Kielce, Pol.	62,113	M 5
Kikinda, Yugo.	29,607	M 6
Kilkenny, Ire.	10,572	F 5
Killarney, Ire.	6,298	F 5
Kilmarnock, Scot.	42,120	G 4
Kingston-upon-Hull (Hull), Eng.	299,068	H 5
Kirkcaldy, Scot.	49,037	G 4
Kirkwall, Orkney Is., Scot.	4,348	G 4
Kiskunhalas, Hung.	32,276	L 6
Kladno, Czech.	19,413	K 5
Klagenfurt, Aus.	62,782	K 6
Klaipeda (Memel), U.S.S.R.	48,545	M 4
Klatovy, Czech.	13,570	K 6
Kłodzko (Glatz), Pol.	22,814	L 5
København (Copenhagen), (cap.), Den.	768,105	K 4
Koblenz (Coblenz), Ger.	66,444	J 5
Koburg (Coburg), Ger.	44,929	K 5
Kokkola, Fin.	13,211	M 3
Kolding, Den.	31,017	J 4
Köln (Cologne), Ger.	594,941	J 5
Komárno, Czech.	17,465	L 6
Kongsberg, Nor.	8,324	J 4
Kongsvinger, Nor.	2,157	K 3
Königsberg (Kaliningrad), U.S.S.R.	150,000	L 4
Konstanz, Ger.	42,934	J 6
Kościan, Pol.	10,800	L 5
Košice, Czech.	66,968	M 6
Koszalin (Köslin), Pol.	17,115	L 5
Kotka, Fin.	24,050	N 3
Kottbus (Cottbus), Ger.	49,131	K 5
Kovno (Kaunas), U.S.S.R.	105,370	M 5
Kraków (Cracow), Pol.	347,517	M 6
Kranj, Yugo.	17,753	K 6
Krefeld, Ger.	171,875	J 5
Krems, Aus.	20,353	L 6
Kristiansand, Nor.	25,815	J 4
Kristianstad, Sweden	25,036	K 4
Kristinehamn, Sweden	19,084	K 4
Krosno, Pol.	13,873	M 6
Krotoszyn, Pol	13,748	L 5
Kuopio, Fin.	33,345	N 3
Kuressaare, U.S.S.R.	4,478	M 4
Kutná Hora, Czech.	16,186	K 5
Kutno, Pol.	20,066	L 5
Kwidzyń, Pol.	7,986	L 5
L'Aquila, Italy	20,573	K 7
La Chaux-de-Fonds, Switz.	33,154	J 6
La Coruña, Spain	†133,844	F 7
La Flèche, Fr.	8,103	G 6
La Línea, Spain	35,446	G 8
La Maddalena, Sardinia, Italy	8,740	K 7
La Roche-sur-Yon, Fr.	15,278	G 6
La Rochelle, Fr.	45,864	G 6
La Seyne-sur-Mer, Fr	18,490	J 7
La Spezia, Italy	109,866	J 7
Lahti, Fin.	44,759	N 3
Lamego, Port	7,449	F 7
Landerneau, Fr	9,175	G 6
Landsberg (Gorzów), Pol.	19,796	L 5
Landshut, Ger	46,785	K 6
Landskrona, Sweden	25,089	K 4
Langres, Fr	5,624	H 6
Lanusei, Sardinia, Italy	4,045	J 8
Laon, Fr.	14,868	H 6
Larvik, Nor	10,311	J 4
Latvian S.S.R., U.S.S.R.	1,800,000	M 4
Lauria, Italy	11,097	L 7
Lausanne, Switz	106,807	J 6
Laval, Fr	28,171	G 6
Le Creusot, Fr.	17,133	H 6
Le Hâvre, Fr	105,491	G 6
Le Mans, Fr.	90,693	H 6
Le Puy, Fr.	18,347	H 6
Lebork, Pol.	10,954	L 5
Lecce, Italy	42,622	L 7
Leeds, Eng	504,954	G 5
Leeuwarden, Neth.	76,679	J 5
Leghorn (Livorno), Italy	140,367	J 7
Legnica (Liegnitz), Pol.	55,949	L 5
Leicester, Eng.	285,061	G 5
Leiden, Neth.	86,914	H 5
Leipzig, Ger.	607,655	K 5
Leiria, Port.	7,123	F 8
Leoben, Aus.	35,319	K 6
León, Spain	†59,549	F 7
Lérida, Spain	†52,849	H 7
Lerwick, Shetland Islands, Scot.	5,538	G 3
Les Sables-d'Olonne, Fr.	17,013	G 6
Leszno, Pol.	20,820	L 5
Levice, Czech.	12,758	L 6
Liberec, Czech.	66,803	L 5
Libourne, Fr.	14,563	H 7
Lidköping, Sweden	14,542	K 4
Liechtenstein	13,757	J 6
Liège (Luik), Belg.	156,208	J 5
Lienz, Aus.	10,024	K 6
Liepāja (Lepaya), U.S.S.R.	75,000	M 4
Lille, Fr.	179,778	H 5
Lillehammer, Nor.	6,634	K 3
Limerick, Ire.	50,820	F 5
Limoges, Fr.	99,535	H 6
Linares, Spain	31,318	G 8
Lincoln, Eng.	69,412	H 5
Linköping, Sweden	54,552	L 4
Linz, Aus.	184,685	K 6
Lisboa (Lisbon) (cap.), Port.	783,226	F 8
Lisieux, Fr.	11,569	H 6
Lithuanian S.S.R., U.S.S.R.	2,700,000	M 4
Liverpool, Eng.	789,532	G 5
Livorno (Leghorn), Italy	140,367	J 7
Ljubljana, Yugo.	138,211	K 6
Ljungby, Sweden	7,155	K 4
Llanelly, Wales	34,329	G 5
Łódź, Pol.	622,495	L 5
Logroño, Spain	†51,975	G 7
Łomza, Pol.	13,772	M 5
London (cap.), England (city-Met. Boroughs)	3,348,336	G 5
London (Greater)	8,346,137	G 5
Londonderry, No. Ire.	50,099	F 5
Lorca, Spain	24,127	G 8
Lorient, Fr.	10,764	G 6
Lourdes, Fr.	12,421	G 7
Lowestoft, Eng.	42,837	H 5
Łowicz, Pol.	13,764	L 5
Lubań, Pol.	8,149	L 5
Lübeck, Ger.	238,276	J 5
Lublin, Pol.	111,025	M 5
Lubliniec, Pol.	11,470	L 5
Lucca, Italy	32,896	K 7
Lucena, Spain	22,797	G 8
Lučenec, Czech.	14,988	L 6
Luckenwalde, Ger.	30,979	K 5
Ludvika, Sweden	10,306	K 3
Ludwigshafen, Ger.	123,869	J 6
Lugo, Spain	†53,743	F 7
Luik (Liége), Belg.	156,208	J 5
Luleå, Sweden	22,514	M 2
Lund, Sweden	33,954	K 4
Lüneburg, Ger.	58,139	K 5
Lunéville, Fr.	19,065	J 6
Luton, Eng.	110,370	H 5
Luxembourg, Lux.	61,996	J 6
Luxembourg	290,992	J 6
Luzern, Switz.	60,526	J 6
Lyon, Fr.	439,861	H 6
Maastricht, Neth.	74,449	J 5
Macerata, Italy	14,460	K 7
Mâcon, Fr.	18,221	H 6
Madrid (cap.), Spain	†1,618,435	G 7
Magdeburg, Ger.	236,326	K 5
Mahón, Balearic Is., Spain	14,651	H 8
Mainz, Ger.	88,369	J 6
Málaga, Spain	†276,222	G 8
Malbork (Marienburg), Pol	10,017	L 5
Mallow, Ire	5,583	F 5
Malmo, Sweden	192,498	K 4
Malta	305,991	K 8
Manchester, Eng.	703,175	G 5
Mannheim, Ger.	245,634	J 6
Manresa, Spain	33,768	H 7
Marburg, Ger	39,530	J 5
Marchena, Spain	16,009	G 8
Maribor, Yugo.	77,124	L 6
Marmande, Fr.	8,190	H 7
Marsala, Sicily, Italy	24,650	K 8
Marseille, Fr.	551,640	H 7
Martina Franca, Italy	20,622	L 7
Mataró, Spain	25,584	H 7
Matera, Italy	21,762	L 7
Mazamet, Fr.	12,058	H 7
Mażeikiai, U.S.S.R.	5,281	M 4
Mechelen (Malines) Belg.	60,288	H 5
Medina del Campo, Spain	13,000	G 7
Melun, Fr.	15,128	H 6
Memel (Klaipeda), U.S.S.R.	48,545	M 4
Menton, Fr.	11,079	J 7
Merano, Italy	22,575	K 6
Mérida, Spain	18,089	F 8
Mértola, Port.	†6,439	F 8
Messina, Sicily, Italy	218,593	K 8
Metz, Fr.	65,472	J 6
Middlesbrough, Eng.	147,336	G 5
Mikkeli, Fin.	15,800	N 3
Milano (Milan), Italy	1,264,402	J 6
Millau, Fr.	15,891	H 7
Minden, Ger.	41,527	J 5
Miranda de Ebro, Spain	12,756	G 7
Miskolc, Hung.	103,724	M 6
Mlawa, Pol.	13,817	M 5
Mo, Nor.	4,211	K 2
Modena, Italy	109,934	K 7
Modica, Sicily, Italy	27,928	K 8
Mohács, Hung.	19,083	L 6
Molde, Nor.	4,167	J 3
Molfetta, Italy	48,898	L 7
Mölndal, Sweden	20,857	K 4
Monaco	20,202	J 7
Monaghan, Ire.	4,723	F 5
Mondovi, Italy	12,498	J 7
Monforte de Lemos, Spain	11,443	F 7
Montalbán, Spain	1,871	G 7
Montargis, Fr.	13,529	H 6
Montauban, Fr.	23,016	H 7
Montélimar, Fr.	10,610	J 7
Montenegro Rep., Yugo.	419,625	L 7
Montluçon, Fr.	45,535	H 6
Montmorillon, Fr.	4,116	H 6
Montpellier, Fr.	80,673	H 7
Montrose, Scot.	10,760	G 4
Monza, Italy	58,503	J 6
Mora, Spain	10,332	G 8
Morastrand, Sweden	3,445	K 3
Morlaix, Fr.	12,176	G 6
Morón de la Frontera, Spain	19,570	F 8
Mosjoen, Nor.	3,349	K 2
Moss, Nor.	18,489	K 4
Most, Czech.	23,110	K 5
Mostar, Yugo.	31,608	L 7
Motala, Sweden	24,723	L 4
Motherwell and Wishaw, Scot.	68,137	G 4
Motril, Spain	15,943	G 8
Moulins, Fr.	20,832	H 6
Mulhouse, Fr.	85,956	J 6
Mullingar, Ire.	5,643	F 5
München (Munich), Ger.	831,937	K 6
Münster, Ger.	118,496	J 5
Murcia, Spain	†218,375	G 8
Naestved, Den.	17,557	K 4
Nagykanizsa, Hung.	28,464	L 6
Nairn, Scot.	4,700	G 4
Nakskov, Den.	16,074	K 5
Namsos, Nor.	4,573	K 3
Nancy, Fr.	108,131	J 6
Nantes, Fr.	187,259	G 6
Napoli, Italy	1,003,815	K 7
Narbonne, Fr.	26,301	H 7
Nässjö, Sweden	15,675	K 4
Nerva, Spain	14,903	F 8
Netherlands (Holland)	9,625,499	H 5
Neubrandenburg, Ger.	20,446	K 5
Neuchâtel, Switz.	27,998	J 6
Neumünster, Ger.	73,481	J 5
Neuruppin, Ger.	26,040	K 5
Neustrelitz, Ger.	24,692	K 5
Nevers, Fr.	32,246	H 6
Newcastle-on-Tyne, Eng.	291,723	G 5
Nicastro, Italy	16,273	L 8
Nice, Fr.	206,750	J 7
Níjar, Spain	2,050	G 8
Nijmegen, Neth.	106,523	J 5
Nîmes, Fr.	75,398	H 7
Niort, Fr.	29,068	G 6
Nitra, Czech.	22,589	L 6
Nogent-le-Rotrou, Fr.	6,439	H 6
Nokia, Fin.	11,867	M 3
Norrköping, Sweden	84,939	L 4
Norrtälje, Sweden	6,526	L 4
Northampton, Eng.	104,429	G 5
Northern Ireland	1,370,709	F 5
Norway	3,278,546	J 3
Norwich, Eng.	121,226	H 5
Noto, Sicily, Italy	18,923	L 8
Notodden, Nor.	6,653	J 4
Nottingham, Eng.	306,008	G 5
Novara, Italy	52,269	J 6
Novi Sad, Yugo.	83,223	L 6
Nowy Sącz, Pol.	23,049	M 6
Nowy Targ, Pol.	8,144	L 6
Nuoro, Sardinia, Italy	10,820	J 7
Nürnberg (Nuremberg), Ger.	362,459	K 6
Nybro, Sweden	6,569	L 4
Nykarleby (Uusikaarlepyy), Fin.	1,131	M 3
Nyköbing, Den.	17,192	K 5
Nyköping, Sweden	20,477	L 4
Oban, Scot.	6,227	G 4
Odense, Den.	100,940	K 4
Oława, Pol.	6,410	L 5
Oldenburg, Ger.	122,809	J 5
Olomouc (Olmütz), Czech.	58,178	L 6
Olot, Spain	11,982	H 7
Olsztyn (Allenstein), Pol.	29,053	M 5
Omagh, No. Ire.	6,762	F 5
Oostende (Ostende), Belg.	49,651	H 5
Opatija, Yugo.	9,280	K 6
Opava, Czech.	32,004	L 5
Opole (Oppeln), Pol.	27,666	L 5
Orange, Fr.	8,145	J 7
Orbetello, Italy	5,528	K 7
Örebro, Sweden	66,548	L 4
Orense, Spain	†55,574	F 7
Orihuela, Spain	10,690	G 8
Oristano, Sardinia, Italy	9,454	J 8
Orléans, Fr.	64,755	H 6
Ornsköldsvik, Sweden	7,356	L 3
Ortigueira, Spain	1,553	F 7
Osijek, Yugo.	57,320	L 6
Oskarshamn, Sweden	10,707	L 4
Oslo (cap.), Nor.	434,047	K 4
Osnabrück, Ger.	109,538	J 5
Östersund, Sweden	21,378	L 3
Ostrava, Czech.	171,064	L 6
Ostróda, Pol.	6,769	L 5
Ostrołęka, Pol.	9,279	M 5
Ostrów, Pol.	30,808	L 5
Ostrowiec, Pol.	19,211	M 5
Oulu, Fin.	37,896	N 2
Oviedo, Spain	†106,002	F 7
Oxford, Eng.	98,675	G 5
Pabianice, Pol.	37,140	L 5
Paderborn, Ger.	40,270	J 5
Padova, Italy	167,068	K 6
Paisley, Scot.	93,704	F 4
Palencia, Spain	†41,769	G 7
Palermo, Sicily, Italy	482,594	K 8
Palma, Balearic Is., Spain	†136,814	H 8
Palmi, Italy	13,590	L 8
Pamiers, Fr.	9,641	H 7
Pamplona, Spain	†72,394	G 7
Panevežys (Panevezhis), U.S.S.R.	23,947	M 4
Pápa, Hung.	21,841	L 6
Pardubice, Czech.	44,557	L 5
Paris (cap.), France	2,691,473	H 6
Parma, Italy	65,126	K 7
Parnu (Pyarnu), U.S.S.R.	20,334	M 4
Passau, Ger.	34,351	K 6
Pau, Fr.	40,604	G 7
Pavia, Italy	40,208	J 6
Pécs, Hung.	77,617	L 6
Pembroke, Wales	12,296	F 5
Penzance, Eng.	20,648	F 5

Périgueux Fr	37 287	H 6
Perpignan Fr	64 358	H 7
Perth Scot	41 465	G 4
Perugia Italy	31 833	K 7
Pesaro Italy	23 161	K 7
Pescara Italy	35 877	K 7
Pessac Fr	16 850	G 7
Peterhead Scot	12 5	G 4
Pforzheim Ger	54 143	J 6
Piacenza Italy	41 527	J 6
Písek Czech	13 305	L 6
Pietarsaari (Jacobstad) Fin	12 400	M 3
Piła (Schneidemühl) Pol	10 671	L 5
Pinerolo Italy	15 361	J 7
Piombino Italy	19 966	J 7
Piotrków Pol	41 141	L 5
Pisa Italy	†75 851	J 7
Pistoia Italy	23 542	K 7
Piteå Sweden	6 574	M 2
Plasencia Spain	14 224	F 7
Plauen Ger	84 778	K 5
Płock Pol	28 508	L 5
Płońsk Pol	7 758	M 5
Plymouth Eng	208 985	G 5
Plzeň Czech	106 904	K 6
Podgorica (Titograd) Yugo	16 333	L 7
Poitiers Fr	41 279	G 6
Pola (Pula) Yugo	29 089	K 7
Poland	24 976 926	L 5
Pontevedra Spain	†43 221	F 7
Pontivy Fr	8 273	G 6
Poprad Czech	10 008	M 6
Pori Fin	43 137	M 3
Porsgrunn Nor	9 456	J 4
Port-Vendres Fr	2 680	H 7
Portalegre Port	10 510	F 8
Porto-Vecchio Fr	1 557	J 7
Porto (Oporto) Port	281 406	F 7
Portsmouth Eng	233 464	G 5
Portugal	8 510 240	F 8
Porvoo (Borgå) Fin	8 537	N 3
Potenza Italy	19 872	L 7
Potsdam Ger	113 568	K 5
Poznań (Posen) Pol	327 192	L 5
Pozoblanco Spain	14 066	F 8
Praha (Prague) (cap) Czech	934 933	K 6
Prešov Czech	24 391	M 6
Prostějov Czech	31 746	L 6
Puertollano Spain	22 761	G 8
Pula (Pola) Yugo	28 089	K 7
Pyarnu (Parnu) U S S R	20 334	M 4
Quimper Fr	17 722	G 6
Radom Pol	83 167	M 5
Ragusa Sicily Italy	40 480	K 8
Ragusa (Dubrovnik) Yugo	19 063	L 7
Rakvere U S S R	10 027	N 4
Randers Den	40 098	J 4
Rauma Fin	15 424	M 3
Ravenna Italy	†92 431	K 7
Ravensburg Ger	25 849	K 6
Reading Eng	114 176	G 5
Regensburg Ger	117 291	K 6
Reggio di Calabria Italy	140 757	L 8
Reggio nell Emilia Italy	106 107	K 7
Reims Fr	106 081	H 6
Rendsburg Ger	36 991	J 5
Rennes Fr	102 617	G 6
Reus Spain	28 573	H 7
Reutlingen Ger	45 735	J 6
Revel (Tallinn) U S S R	190 000	N 4
Rhondda Wales	111 357	G 5
Rieti Italy	14 366	K 7
Riga U S S R	390 000	M 4
Riihimäki Fin	12 030	N 3
Rijeka (Fiume) Yugo	75 112	K 6
Rimini Italy	31 505	K 7
Roanne Fr	40 216	H 6
Rochefort Fr	22 930	G 6
Rodez Fr	16 366	H 7
Roma (*Rome*) (cap) Italy	1 606 739	K 7
Romans Fr	18 865	J 6
Ronda Spain	15 629	F 8
Rønne Bornholm Den	12 696	K 5
Ronneby Sweden	1 725	L 4
Roskilde Den	26 355	K 4
Rostock Ger	114 869	K 5
Rotterdam Neth	646 248	H 5
Roubaix Fr	98 834	H 5
Rouen Fr	101 187	H 6
Rovigo Italy	14 561	K 7
Ruma Yugo	15 618	M 6
Russian Sov Fed Soc Rep U S S R	111 000 000	M 5
Rzeszów Pol	29 407	M 5
's Gravenhage (The Hague) (cap) Neth	532 998	H 5
Saar Germany	851 615	J 6
Saarbrücken Ger	89 700	J 6
Šabac Yugo	19 987	L 7
Sabadell Spain	40 449	H 7
Sahagún Spain	3 759	G 7
Saint Andrews Scot	9 459	G 4
Saint-Brieuc Fr	28 506	G 6
Saint-Denis Fr	69 595	H 6
Saint-Dié Fr	11 423	J 6
Saint-Dizier Fr	15 9 6	H 6
Saint-Étienne Fr	156 315	H 6
Saint Gallen Switz	64 011	J 6
Saint-Germain-en-Laye Fr	20 023	H 6
Saint-Jean-de-Luz Fr	8 848	G 7
Saint Lô Fr	5 190	G 6
Saint-Malo Fr	10 873	G 6
Saint-Mihiel Fr	4 134	J 6
Saint Moritz Switz	2 558	K 6
Saint Nazaire Fr	4 408	G 6
Saint-Quentin Fr	46 876	H 6
Saint-Tropez Fr	3 171	J 7
Saintes Fr	2 711	G 6
Salamanca Spain	†80 239	F 7
Salerno Italy	41 925	K 7
Salgótarján Hung	20 134	L 6
Salisbury Eng	32 910	G 5
Salzburg Aus	102 927	K 6
San Fernando Spain	31 811	F 8
San Marino	12 987	K 7
San Remo Italy	23 063	J 7
San Sebastián Spain	†113 776	G 7
San Severo Italy	37 159	L 7
Sandomierz Pol	8 357	M 5
Sandviken Sweden	18 744	L 3
Sankt Pölten Aus	40 203	L 6
Sanlúcar de Barrameda Spain	24 741	F 8
Santander Spain	†102 462	G 7
Santarém Port	13 114	F 8
Santiago Spain	25 795	F 7
Sarajevo Yugo	135 657	L 7
Sarpsborg Nor	13 234	K 4
Sassari Sardinia Italy	†70 324	J 7
Saumur Fr	14 845	G 6
Savona Italy	57 354	J 7
Scarborough Eng	43 983	H 5
Schaffhausen Switz	29 971	J 6
Schleswig Ger	35 247	J 5
Schwerin Ger	88 164	K 5
Sciacca Sicily Italy	17 265	K 8
Scotland	5 095 969	G 4
Scutari (Shkodër) Alb	33 852	L 7
Sedan Fr	12 987	H 6
Segovia Spain	†29 568	G 7
Sens Fr	15 936	H 6
Seo de Urgel Spain	3 588	H 7
Serbia Rep Yugo	6 983 544	L 7
Sète Fr	29 914	H 7
Setúbal Port	†44 235	F 8
Sevilla Spain	†376 627	F 8
Sheffield Eng	*512 834*	G 5
Shkodër (Scutari) Alb	33 852	L 7
Šiauliai (Shaulyay) U S S R	35 000	M 4
Šibenik Yugo	18 959	L 7
Siedlce Pol	25 562	M 5
Siena Italy	28 064	K 7
Silkeborg Den	23 372	J 4
Siracusa Sicily Italy	†70 060	L 8
Sisak Yugo	19 125	L 6
Skellefteå Sweden	14 065	M 3
Skierniewice Pol	17 866	M 5
Skövde *Sweden*	*17 723*	K 4
Slavonski Brod Yugo	21 547	L 6
Sligo Ire	13 529	F 5
Slovenia Rep Yugo	1 462 961	K 6
Słupsk (Stolp) Pol	33 948	L 5
Söderhamn Sweden	11 514	L 3
Södertälje Sweden	25 286	L 4
Soissons Fr	17 136	H 6
Solbad Hall (Hall) Aus	11 057	K 6
Sollefteå Sweden	8 330	L 3
Solna Sweden	37 311	L 4
Sombor Yugo	*26 586*	L 6
Sønderborg Den	16 204	J 4
Sondrio Italy	7 639	K 6
Sopron Hung	42 255	L 6
Soria Spain	†16 878	G 7
Sorrento Italy	7 031	K 7
South Shields Eng	106 605	G 4
Southampton Eng	178 326	G 5
Southend-on-Sea Eng	151 830	H 5
Sovetsk (Tilsit) U S S R	57 244	M 5
Spain	27 976 755	G 7
Spittal Aus	8 682	K 6
Split Yugo	75 377	L 7
Sremska Mitrovica Yugo	15 416	L 6
Stargard Pol	9 733	L 5
Starogard Pol	15 081	L 5
Stavanger Nor	50 647	H 4
Stendal Ger	40 325	K 5
Šternberk Czech	12 566	L 6
Stettin (Szczecin) Pol	200 217	K 5
Steyr Aus	36 818	K 6
Stockholm (cap) Sweden	745 936	L 4
Stockton-on-Tees Eng	74 024	G 5
Stoke-on-Trent Eng	275 095	G 5
Stornoway Hebrides Scot	4 954	F 4
Stralsund Ger	60 389	K 5
Stranraer Scot	8 622	G
Strasbourg Fr	167 149	J 6
Stuttgart Ger	497 677	J 6
Subotica Yugo	115 402	M 6
Sueca Spain	17 024	H 8
Sulmona Italy	16 8 4	K 7
Sunderland Eng	181 515	G 5
Sundsvall Sweden	25 7	L 3
Suwałki Pol	13 6 0	M 5
Svendborg Den	21 069	K 4
Swansea Wales	*160 832*	G 5
Sweden	7 046 920	L 3
Świdwin Pol	6 098	L 5
Świebodzin Pol	6 141	L 5
Świnoujście (Swinemünde) Pol	6 771	K 5
Switzerland	4 714 992	J 6
Szczecin (Stettin) Pol	200 217	K 5
Szczecinek Pol	1 413	L 5
Szeged Hung	132 616	L 6
Székesfehérvár Hung	41 574	L 6
Szekszárd Hung	14 945	L 6
Szentes *Hung*	*3 800*	M 6
Szolnok Hung	36 013	M 6
Szombathely Hung	40 114	L 6
Tábor Czech	16 975	K 6
Talavera de la Reina Spain	14 001	F 8
Tallinn (Revel) U S S R	190 000	N 4
Tampere Fin	103 043	M 3
Taranto Italy	166 957	L 7
Tarazona de Aragón Spain	10 240	G 7
Tarbes Fr	42 778	H 7
Tarnów Pol	33 108	M 5
Tarragona Spain	†38 841	H 7
Tarrasa Spain	44 3	H 7
Taunton Eng	33 613	G 5
Terni Italy	37 295	K 7
Terranova Pausania Sard Italy	7 799	J 7
Teruel Spain	†18 74	G 7
Thionville Fr	15 195	J 6
Thorshavn Faroe Is Den	4 390	F 3
Thouars Fr	9 865	G 6
Thurles Ire	6 2 8	F 5
Tilburg Neth	114 312	J 5
Tilsit (Sovetsk) U S S R	57 244	M 5
Tipperary Ire	*5 148*	F 5
Tirane (Tirana) (cap) Alb	59 887	L 7
Titograd (Podgorica) Yugo	16 333	L 7
Titovo Užice Yugo	13 268	L 7
Toledo Spain	†40 243	G 8
Tolosa Spain	9 592	G 7
Tomelloso Spain	29 0 4	G 8
Tønsberg Nor	12 211	J 4
Torino Italy	711 492	J 6
Tornio Fin	3 282	M 2
Torquay Eng	53 216	G 5
Torre Annunziata Italy	39 606	K 7
Torrelavega Spain	*9 243*	G 7
Tortosa Spain	11 410	H 7
Toruń (Thorn) Pol	79 979	L 5
Toulon Fr	116 143	J 7
Toulouse Fr	22 854	H 7
Tours Fr	76 207	H 6
Trapani Sicily Italy	52 661	K 8
Trbovlje Yugo	16 595	L 6
Třebíč Czech	17 210	L 6
Trelleborg Sweden	17 126	K 4
Trento Italy	†62 0 8	K 6
Treviso Italy	43 949	K 6
Trier Ger	75 528	J 6
Trieste (cap) Trieste	*271 899*	K 6
Trieste Free Terr of	369 729	K 6
Trollhättan Sweden	21 143	K 4
Trondheim Nor	56 669	K 3
Troyes Fr	53 521	H 6
Trujillo Spain	5 894	F 8
Truro Eng	12 851	F 5
Trutnov Czech	14 244	L 5
Tübingen Ger	37 508	J 6
Tukums U S S R	8 144	M 4
Tulle Fr	14 744	H 6
Turin (Torino) Italy	711 492	J 6
Turku Fin	101 239	M 3
Tuzla Yugo	31 227	L 7
Úbeda Spain	21 044	G 8
Uddevalla Sweden	24 922	K 4
Udine Italy	54 6 8	K 6
Ulm Ger	71 132	K 6
Umeå Sweden	17 113	M 3
Union of Soviet Socialist Republics	201 300 000	N 4
Uppsala Sweden	63 072	L 3
Ústí Czech	60 415	K 5
Utrecht Neth	18 246	J 5
Vác Hung	22 130	L 6
Valdepeñas Spain	29 863	G 8
Valence Fr	34 249	J 7
Valencia Spain	†5?9 0 5	H 8
Valladolid Spain	†124 212	G 7
Valletta (cap) Malta	18 666	K 8
Vännäs Sweden	3 0 5	L 3
Vannes Fr	23 510	G 6
Varaždin Yugo	19 39	L 6
Varberg Sweden	12 524	K 4
Varese Italy	23 349	J 6
Vasa (Vaasa) Fin	3 0	M 3
Västerås Sweden	59 990	L 4
Västervik Sweden	15 741	L 4
VATICAN CITY Italy	1 010	K 7
Växjö Sweden	20 104	L 4
Vejle Den	29 448	J 4
Vélez Málaga Spain	11 114	G 8
Velletri Italy	20 419	K 7
Vendôme Fr	7 9 7	H 6
Venezia Italy	315 291	K 6
Ventspils U S S R	1 679	M 4
Vercelli Italy	32 397	J 6
Verdun France	12 948	J 6
Verona Italy	176 911	K 6
Versailles Fr	63 114	H 6
Veszprém Hung	18 240	L 6
Viana do Castelo Port	14 023	F 7
Viareggio Italy	30 384	J 7
Vibo Valentia Italy	10 073	L 8
Viborg Den	21 572	J 4
Vicenza Italy	*48 2 9*	K 6
Vichy Fr	29 144	H 6
Vienna (Wien) (cap) Aus	1 766 102	L 6
Vienne Fr	19 959	J 6
Vierzon Fr	24 502	H 6
Vigo Spain	†137 873	F 7
Vila Real Port	9 285	F 7
Viljandi U S S R	11 789	N 4
Villach Aus	30 066	K 6
Villanueva de la Serena Spain	16 522	F 8
Villarreal Spain	16 793	G 8
Villarrobledo Spain	19 390	G 8
Villefranche-sur-Saône Fr	19 391	J 6
Villeurbanne Fr	80 193	J 6
Vinkovci Yugo	20 670	L 6
Viseu Port	13 190	F 7
Viterbo Italy	21 281	K 7
Vitoria Spain	†52 206	G 7
Vittorio Veneto Italy	12 034	K 6
Vrbas Yugo	15 462	L 6
Vukovar Yugo	18 656	L 6
Wałbrzych (Waldenburg) Pol	81 2 0	L 5
Wales	2 172 339	G 5
Warszawa (Warsaw) (cap) Pol	*641 877*	M 5
Waterford Ire	28 691	F 5
Weimar Ger	66 659	K 5
Wels Aus	38 078	K 6
Wexford Ire	11 979	F 5
Weymouth Eng	37 097	G 5
Wien (Vienna) (cap) Aus	1 766 102	L 6
Wiesbaden Ger	220 741	J 5
Wilhelmshaven Ger	101 210	J 5
Winterthur Switz	66 925	J 6
Wismar Ger	42 018	K 5
Wittenberge Ger	31 485	K 5
Włocławek Pol	54 650	L 5
Wolverhampton Eng	162 669	G 5
Worcester Eng	59 700	G 5
Workington Eng	28 882	G 5
Wrocław (Breslau) Pol	341 419	L 5
Wuppertal Ger	363 224	J 5
Würzburg Ger	78 443	K 6
Yecla Spain	20 090	G 8
York Eng	105 336	G 5
Yugoslavia	16 927 275	L 7
Zabrze (Hindenburg) Pol	132 888	L 5
Zadar (Zara) Yugo	18 913	L 7
Zagreb Yugo	350 452	L 6
Zalaegerszeg Hung	15 187	L 6
Zamora Spain	†38 320	F 7
Zara (Zadar) Yugo	18 913	L 7
Zaragoza Spain	†264 256	G 7
Zawiercie Pol	21 225	M 5
Zenica Yugo	28 809	L 7
Zielona Góra (Grünberg) Pol	15 738	L 5
Zlín (Gottwaldov) Czech	42 152	L 6
Znojmo Czech	17 987	L 6
Zrenjanin Yugo	*44 217*	M 6
Zürich Switz	390 020	J 6
Zvolen Czech	14 342	L 6
Zwickau Ger	122 862	K 5
Zwolle Neth	47 462	J 5
Żyrardów Pol	20 186	M 5

THE ROOTS OF MANY EUROPEAN PROBLEMS


There are 38 "national groups" in Europe

Albanians	French	Portuguese
Austrians	Germans	Rumanians
Basques	Great Russians	Scots
Bulgarians	Greeks	Serbs
Catalonians	Hungarians	Slovaks
Croats	Irish	Slovenes
Czechs	Italians	Spaniards
Danes	Latvians	Swedes
Dutch	Lithuanians	Swiss
English	Montenegrins	Turks
Esthonians	Norwegians	Ukrainians
Finns	Poles	Walloons
Flemings		Welsh




There are 28 chief languages

English

Greek

Russian

Hungarian

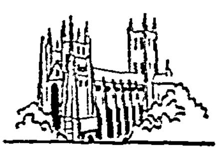
Italian

Albanian	English	Hungarian	Russian
Basque	Esthonian	Italian	Serbian
Bulgarian	Finnish	Lithuanian	Slovak
Catalonian	French	Norwegian	Slovenian
Czech	Gaelic	Polish	Spanish
Danish	German	Portuguese	Swedish
Dutch	Greek	Rumanian	Turkish

(Road signs illustrate the extreme differences of language)

German

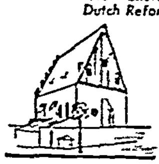
There are 7 principal religious denominations

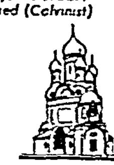

Canterbury Cathedral
Anglican (Episcopal)

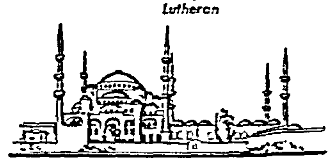

New Church, Amsterdam
Dutch Reformed (Calvinist)


St. Nicholas, Stockholm
Lutheran


St. Peter's
Roman Catholic


Old-New Synagogue
Prague—Jewish


Church in Bucharest
Eastern Orthodox


Blue Mosque, Istanbul
Mohammedan

Prevailing westerly winds carry warm air and rainfall deep inland for there are *no great north south mountain ranges* to block the winds The heaviest rainfall comes in the growing season Except in the north the climate can support an abundant natural growth of deciduous forests

The marine influence decreases toward the east where the land mass broadens to meet the great north south span of Asia Here the climate becomes *continental* Summer and winter temperatures differ more *than in the west* But even here some of the ocean's influence is felt The moist air penetrates farther eastward in summer and rainfall is heaviest at this season Areas in the south central plains in Hungary and Rumania have the same type of warm humid climate *found in the United States* between the cotton belt and the corn belt But this climate is found 500 to 600 miles farther north in Europe than in America The climate is fully continental in Russia with severe winters and hot summers In southern Russia *rainfall* is not sufficient to support forests Here the broad grassy steppes (prairies) stretch eastward into Asia and a true desert area lies north of the Caspian Sea

Southern Europe has a *Mediterranean* climate (The name is applied also to the climates of southern California and of certain parts of the Chilean coast) The summers are hot and dry and the winters are cool and rainy

FROST FREE SEASON FOR GROWING CROPS

This map shows how Europe's mild climate favors agriculture Most of western *Europe* has a six to nine month growing season In the United States only the South and the West coast have so many frost free months In Europe only the high *Alps* and the highlands and interior plains of the Far North have less than three months The eastern plain averages three to six months

The Many Peoples and Languages of Europe

EUROPE is the most densely populated of the continents. With but 8 per cent of the earth's land surface it is home to about one-fourth of the world's people. The entire continent holds an average of more than 140 persons to the square mile. Europe west of Soviet Russia has an average density of 350 or more to the square mile; and industrial countries such as England, the Netherlands, and Belgium have more than 700 to the square mile.

These figures stand in striking contrast with a population density of 50.7 to the square mile in the United States and more than 75 in Asia. Some portions of Asia are more crowded than Europe, but in those portions the masses of the people have a miserably low standard of living. In Europe, living standards have generally been above the average for the world; and they have been exceeded in America only in recent generations.

How Europe Was Populated

People have lived in Europe for countless ages. When the glaciers of the Ice Age covered the north and the high mountain ranges, early races of men were living on the Mediterranean coast and in ice-free regions in Spain, France, Germany, and elsewhere. After the ice receded, new peoples flooded into the continent from Africa and in larger numbers from Asia. Migrations continued into historic times, even to the end of the Middle Ages. Most of the present population has descended from these immigrants who came after the Ice Age.

When this immigration started, the beginnings of civilization had already been developed in western Asia, in Egypt, and in India. Men had learned to plant crops, domesticate animals, and live in permanent homes. They could make pottery and could spin and weave. They made tools of polished stone and were beginning to use metal, starting with copper.

These skills were brought to Europe by many routes. Some seafaring peoples worked along the Mediterranean and Atlantic coasts, and established settlements. Other immigrants crossed the narrow Turkish Straits, then spread through the Balkans and up the Danube Valley, into Western Europe, particularly along the mountain backbone of the continent.

Still more immigrants came from the grasslands around the Black Sea and east of it. The people who came from this region spoke Indo-European languages and were originally nomadic herdsmen. From time to time waves of them pushed westward, chiefly into the forested northern plain. Some moved across the mountains to the south, pushing aside or conquering the earlier inhabitants. In the end they established themselves throughout Europe. The people who came to be known in history as the Greeks, Romans, and Teutons were descendants of these migrants.

Thus Europe has come to be populated by a mixture of peoples. Today there are probably no pure racial strains on the continent. But certain physical types predominate in various regions. In the north, the majority of the people are tall, blonde, and longheaded. This stock has been called Nordic. In the center, the Alpine stock predominates. These folk are roundheaded, with a short, thickset frame, brown hair, and brown or grey eyes. Along the southern coasts live the Mediterranean people with dark skin, black eyes and hair, and long heads. All these stocks belong to the white race.

Languages and Religions

The peoples of Europe speak 50 or 60 languages. This confusion of tongues has been a barrier to understandings between peoples and has hampered trade and communication.

All but a few languages are derived from the root language called Indo-European, or Aryan (*see* Language and Literature). The many languages belong to three major groups. They are the Germanic languages, including English, German, and the Scandinavian tongues; the Romance languages, derived from Latin and spoken along the Mediterranean and in southern Belgium and Rumania; and the Slavic languages, spoken by most of the people of Russia, Poland, Czechoslovakia, Yugoslavia, and Bulgaria.

Christianity dominates the continent. The few Mohammedans reside mainly in the Balkans. Members of the Jewish faith are scattered over the continent.

The major Christian groups are the Roman Catholic, the Greek Orthodox, and the Protestant. Northwestern Europe is predominantly Protestant and southern Europe mainly Roman Catholic. In eastern Europe, the Greek Orthodox church has historically been the prevailing faith. Since the foundation of a Communist government in Russia, antireligious agitation has weakened this church there.

Characteristics of the People

Europeans are famous for their energy, resourcefulness, and ability. Some scholars believe that the vigor and intensive activity of European stocks is due in part to the climate. They hold that the moist, changeable weather is stimulating and that temperatures over most of the continent are those favorable to mental and physical energy.

Evidence of these qualities is not limited to the great achievements of historic leaders. Examples of the application of hard, skillful work and ingenuity in making the best of available resources may be seen on every side. Farmers fertilize their land and use intensive cultivation to get high yields from small acreage. Along the Mediterranean they extend tillable land by building mountain terraces and filling them with rich soil, and by irrigating dry areas. In the Low Countries, they drain land below sea level.

Many European manufacturing specialties are based on the skillful, patient toil of the workers. The famous Swiss watches were originally assembled in the homes of farm folk who sought extra work during the snowy winter. Abundant skilled man power permits European industry to exploit low-grade ores that could not be economically used elsewhere. European retail

trade has as its basis the small family shop in which husband and wife work long hours and watch the pennies cen times or drachmas closely

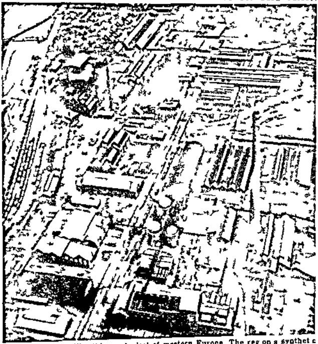
Industry and Commerce

Europe is the most highly industrial ized continent In normal times its fac tories turn out the greatest variety amount and value of goods Though its mineral resources are not so great as those of North America Europe is com monly the greatest user of minerals

Europe had the advantage of an early start The Industrial Revolution began in England in the 18th century and spread to mainland western Europe Eu ropeans offered a large market for such consumer goods as textiles The popula tion more than doubled in the 19th cen tury for industry gave a livelihood to many more people than farming sup ported But production far outgrew home demand as Europeans improved industrial methods with scientific d s coveries and inventions

Europeans expanded their foreign trade enormously and their industry be came dependent upon foreign markets They also looked to distant areas for industrial raw materials and for food for the huge population The wars in the 20th century blocked their foreign trade and de stroyed many industrial plants Meanwhile United States industry had expanded to meet war demands and offered stiff competition in world trade

A HUGE CHEMICAL PLANT IN FRANKFORT ON THE MAIN



Industrial scenes like this are typical of western Europe The reg on s synthet c chem cal industry is based on the scient fic knowledge and exper ments on of its enterpr s ng and educated peoples I s coal and b nes furnish the raw mater a s

In the arduous task of reviving industry and trade Europe s industrial countries were further hampered by the fact that agricultural regions around the world had begun programs of industrial expansion Polit cal conflicts had also curtailed the normal flow of trade between the industrial west and the agricultural coun tries of eastern Europe, which were dominated by Soviet Russ a

Farming to Feed the Huge Population

Despite its industrial transformation Europe is still a great agricultural continent It surpasses any other continent in output of crops suited to middle-lat tude climates About half of its people depend upon farming for a livelihood

Europeans consume the bulk of the farm produce Since the continent cannot ship great surpluses into world trade, it is difficult to realize that its out put of grain for instance is larger than that of most of the great exporting regions But European fields produce in normal t mes four fifths or more of the world s total output of rye potatoes sugar beets flax fiber olive oil and grapes half of the oats and barley and almost half of the milk and wheat

Fisheries of the Maritime Nations

Europe s people have used the favorable coast line and surrounding seas to develop a great fi hing in dustry Each seaboard reg on has its fisheries The North Sea yields the largest catch On the famous Dogger Bank in the center more than 30 000 fishing boats gather from the ports of surrounding countr es

The Med terranean s warm waters are not so well stocked with fish as the colder seas but fishing boats work out of the ports and help to supply the people s food needs F sheries and seafaring have been impor tant in Greece since ancient times Fishing fleets from Europe also ply their trade in d stant waters They bring home rich catches from the coasts of Iceland West Africa and the Grand Banks of Newfoundland

Regions of Europe and How Men Use Them

ON THE basis of its physical features the continent may be divided into six regions They are (1) The *northwest highlands* stretching from northern Ireland a ross northern Scotland to the mounta ns of the Scandinavian Peninsula and northern Finland (2) the *northern plain* starting in the lowlands of the British Isles and extending in an arc across Europe from northern France to Russia where it expands to cover the vast area from the Arctic Ocean to the Black Sea (3) the *central uplands* (4) the *southern moun tains* (5) The *Med terranean peninsulas* (6) the mountain girt plains of Hungary and Rumania

In discussing the use of these regions, the northern plain and the central uplands will be considered as one geographic region. The southern mountains, their basins, and the Mediterranean peninsulas formed by these mountains will be treated together.

The Northwest Highlands NATURE has been niggardly with this rugged area. The landscape is mainly bare, rocky highland splashed with the blue of lakes scooped out by Ice Age glaciers. Along the west coasts, sheer cliffs drop to a coast fringed with peninsulas and islands. Narrow, deep drowned valleys penetrate the rocky coast, making sheltered harbors. In Norway these fingers of the sea are called *fjords*, in Scotland, *firths*. The Kjölen Mountains, the "keel" of the Scandinavian Peninsula, slope gently eastward to Sweden's Baltic shore.

The mountains are of only moderate height. Scotland's Highlands rise no higher than Ben Nevis, 4,406 feet above sea level, and Scandinavia's highest peak is Galdhöpiggen, 8,160 feet in altitude.

Climate, Plants, and Trees of the Northwest

Rising from the sea on Europe's west coast, the highlands get the full effect of the moist winds blowing from the Atlantic. Cloudy, grey skies are common and heavy rains fall. Norway's western slopes probably receive the greatest precipitation (rain and snow) in Europe.

Cloudiness interferes with the growth of crops and trees in westward-facing areas. But Norway's southeastern slope and most of northern Sweden and Finland are covered with dense forests of pine, spruce, and birch. This is part of the coniferous forest shown stretching across northern Europe on the vegetation map. Northern highlands of Ireland and Scotland have broad stretches of heath, moor, and peat bogs. (Similar landscapes are found in Wales and in the uplands of Brittany in France, which are sometimes included in the northwest highland region.)

Since more than 15 degrees of latitude separate Ireland from northern Norway, a wide difference in climate might be expected. But the sea winds tend to make the climate uniform along the Atlantic coastline. Summers are cool. Winters, though very mild for the latitude, have raw winds and frequent storms.

Away from the coast, winters in Scandinavia and Finland are severe. Darkness lasts much of the day in midwinter, for the region stretches far north of the Arctic Circle (*see* Arctic Regions). Norway's high plateau holds the largest glaciers in Europe. High land in the Far North lies frozen most of the year and bears only meager tundra growth.

How the Sea Helps the People

This chill, rugged region is thinly populated. People find difficulty in earning a living here. Where the land is so inhospitable, it is natural that many should turn to the sea for a livelihood. This region has a larger proportion of people engaged in seafaring and fishing than any other. Norwegians own and man one of the world's great merchant fleets. Their fishing boats bring in one of the largest annual catches.

The Scottish people have long been famed as mariners. Glasgow is one of the world's great shipbuilding centers. Belfast, Ireland, is a center for shipbuilding and sea trading. Fishing towns dot France's Breton coast.

Use of the Land's Resources

The other principal occupations are lumbering, mining, and stock raising. The Swedes and Finns are leading lumber producers. Their lumber and pulp are exported throughout the world. The principal deposit of mineral wealth is the rich iron ore of northern Sweden. Copper is found near by. The iron ore goes by rail and sea to Europe's steel mills. Coal is lacking, but the people are developing hydroelectric power from their mountain streams. Wales has rich coal veins and mining is the chief occupation of the Welsh.

Only a small part of the northwest highlands is suited to cultivation. In northern Ireland and Scotland farmers can raise hardy crops, such as oats, barley, flax, and potatoes, in a few sheltered valleys. They pasture cattle and sheep on the rocky uplands. The textile mills of the two countries make beautiful cloth from the flax and wool.

In the mountainous parts of Scandinavia, farming suffers from the cool, short growing season, the scarcity of level land, and the poor soil. Along the mild west coast, thrifty farm families care for dairy cattle and grow hardy cereals, potatoes, and hay for winter feed.

Sweden's Norrland has a wider plain than Norway, but the growing season is too brief for most crops. The cut-over forest land has poor podsol soils. In the far northern upland of Scandinavia and Finland, a small, sturdy, dark-skinned folk, the Lapps, live by herding the reindeer that feed on the tundra growth. (The populous lowland tip of the Scandinavian Peninsula is part of the northern plain region.)

The Northern Plains and Central Uplands EUROPE'S largest and richest region is the northern transcontinental plain. It is really two regions: the narrow western lowland, studded on the south by the hills and plateaus of the central uplands; and the vast eastern plain filling the widest part of the continent from the Arctic to the Black and Caspian seas and from the Baltic to the Urals.

The western section is the most highly industrialized and most densely populated part of Europe. It faces the Atlantic and receives its mild, moist climate and its immense foreign trade from that great sea. It is carved into a mosaic of countries, each important in commerce, industry, and world affairs.

In the west the plain is broken by hills and deep valleys and by the dikes and canals of the Low Countries. Small plains cut off by uplands include the Paris basin of France. The Anglo-Flemish basin lies partly in Britain and partly on the continent—cut in two by the North Sea. Along the Baltic coast the plain is broken by the moraines, eskers, and drumlins left behind by the glaciers. Only in eastern

Germany and Poland does the land begin to have the unbroken sweep of the broad Russian plain

The Flat Eastern Plain

The eastern plain contains well over half of the land in Europe but it all lies within one country—Soviet Russia. It composes but a third of that vast nation. Most of the area is thinly settled but more densely populated belts contain commercial and industrial cities. Thousands of miles inland from the Atlantic it receives moderate to scanty rainfall. Summers are hot and in the cold winters bitter Siberian winds can sweep over the whole unobstructed plain. Its commerce reaches world trade by indirect north or south routes through the Arctic or the Black and Mediterranean seas.

The eastern plain appears flat throughout its expanse. The gradual downward slope from the Valdai Hills in the northwest is shown by the lazy flow of the rivers. In the east the ground slopes up toward the ranges of the Ural Mountains.

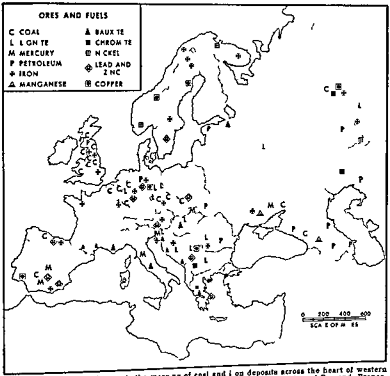
Since the entire eastern plain lies in Soviet Russia a discussion of its soil, natural vegetation, crops, minerals and industrial development may be found in the article on Russia. Maps on a preceding page of this article show the location of the vegetation zones and the distribution of population.

Advantages of the Western Plain

Europe's western lowland contains the advantages found in the northeastern quarter of the United States reduced to a small convenient scale. In America however the iron ore of the Lake Superior district and the agricultural produce of the grain belt are separated from the commerce and industry of the eastern coast by nearly 1 000 miles and by a broad highland. The coal of the highland must often be hauled long distances to mills and factories.

In western Europe iron and coal lie close together round the foothills of the Hercynian range or central uplands. Adjacent fertile fields produce high yields. The large population supplies skilled workers for the factories and farms and their output can move quickly into world commerce on the navigable rivers and the bordering seas.

LEADING DEPOSITS OF FUELS AND METALS



A striking feature of this map is the massing of coal and iron deposits across the heart of western Europe along the foothills of the central uplands. Most of the industrial cities of England and France, Belgium, Germany and Czechoslovakia have risen near these deposits. The iron ranges of Sweden and scattered ore reserves of many other areas help to supply ores for the huge metallurgical industries. Notice that the only large reserves of petroleum lie in Rumania and Russia.

Comparison of the population map with the minerals map reveals that the greatest concentration of industrial cities fringes the coal and iron deposits of the central lowland. England, Wales and Scotland have more than a quarter of Europe's coal reserve; western Germany, Holland, Belgium and France more than a third; eastern Germany and southwestern Poland a fifth.

Lignite is mined in Germany and Czechoslovakia. The largest iron deposits lie in Lorraine in northeastern France but England, Germany and Poland have considerable deposits and the rich output of northern Sweden is available by sea. The copper, lead and zinc of the region no longer fill the needs of industry and supplies must be imported.

The iron and steel industry borders the coal and iron deposits and with it goes specialization in machinery, electrical equipment, shipbuilding and other steel-using products. Chemical production is also important here. The coal and brines of the area supply raw material.

Textile manufacturing is another specialty in this densely populated belt. England's woolen mills and Belgium's linen manufacturing were founded on home-grown wool and flax but today many textile raw materials are imported and rayon fiber is manufactured

These are but a few of the manufactures, since this thickly peopled area makes hundreds of products for home demand and foreign markets.

Many port cities specialize in smelting ores, refining petroleum, making sugar, and otherwise processing the crude materials that arrive from abroad. England, France, Belgium, and the Netherlands have overseas territories that produce many of these valuable raw materials.

Soils and Agriculture in the West

Great forests once grew on the plain and left their mark on the soil. Where the cone-bearing trees once stood, poor podsols may be found. But most of the western plain was covered by mixed forest or by leafy trees, and the soils range from brown forest soil to red and yellow podsolic. River valleys have rich soils brought down from the uplands. The drizzling rains of the western part of this region do not leach plant food from the soil as badly as would downpours.

Along the Baltic the original soil was a mixture of clay, sands, and gravels deposited by streams flowing from the glaciers. South of the glaciated area, a layer of extremely fertile loess soil spreads over parts of France, Germany, Poland, Rumania, and the plain of southern Russia. This fine-grained clay was ground by the glaciers and then blown southward.

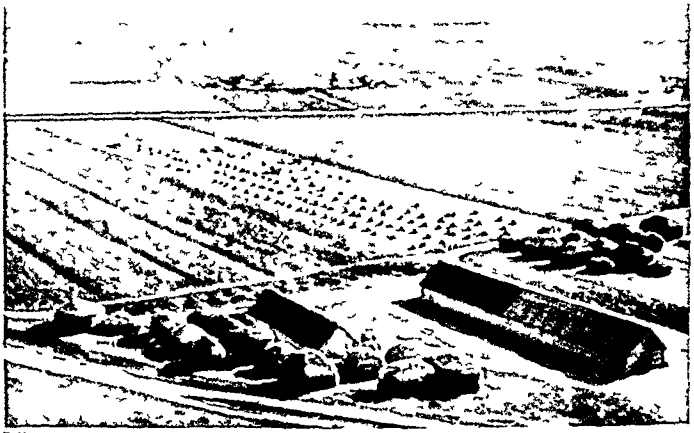
Scarcely any of the soil remains in its natural state in this long-cultivated region. The farmers have improved their ground through fertilization, crop rotation, and other scientific methods. The extensive herds of livestock provide manure to enrich the land, and Europe produces abundant mineral fertilizers.

Through intensive cultivation the farmers raise big crops on their acres. The Danish, Dutch, and Belgian farmers are especially noted for large yields. These three countries have also extended their land by huge drainage projects. Dairy farming is their specialty. Dairying and stock raising have become more important throughout the western lowlands in recent decades. The dairies and the truck farms and orchards supply food for the huge city populations.

The leading field crops of the cool, moist area are rye, oats, barley, buckwheat, potatoes, sugar beets and other root crops, and hay. Although some wheat is grown throughout, the largest crops come from France and central Germany. The French basins are warmer than the northern plain and grow a greater variety of crops. The abundant grapevines furnish the raw material for the famous French wines.

The central uplands produce much the same crops as the adjoining lowlands. Their gentle slopes are tilled and there are many lush valleys. Trees are cultivated on the steep slopes as well as on the sandy and marshy parts of the plain. Southward-facing slopes in the valleys are terraced for vine culture.

A WHEAT FARM ON THE RUSSIAN PLAIN



Wheat fields spread toward the horizon on the level plain. This is a part of a huge collective farm established by the Communist Soviet government. Only barns and storehouses appear here, since the people live in villages

Southern Mountains and Peninsulas

MOUNTAINS dominate the life of Europe from the Alpine ranges southward. The high mountain areas and the Mediterranean peninsulas therefore have enough in common to be considered a single region, though many contrasts appear.

Climatic contrasts are numerous. Valleys, low plateaus, and basins in the Alps and in the Balkans have ranges of temperature and rainfall similar to those of the lowland north of them. Rain is abundant in the west and decreases toward the east. Temperatures decrease with altitude. The highest Alpine ranges have year-round snow fields and huge glaciers. The peninsulas have the hot, dry summers and mild, rainy winters of the Mediterranean climate. High westward-facing slopes rob the winter winds of their moisture and receive more rain and snow. The interior plateaus of Spain are drier than the coast because the border ranges intercept the rain.

The vegetation map on an earlier page shows how forests and other vegetation reflect the differences in the climate. The Alpine ranges have mixed forests on their lower slopes and pines climbing toward the timber line. High meadows provide summer pastures. Alpine flowers bloom near the snow line.

Mediterranean vegetation is adapted to the summer drought. Trees bear small, leathery evergreen leaves or needles to resist evaporation. These include pines, cypresses, cedars, cork oaks, laurels, and wild olives. Where the forest has disappeared, the scrub, called *maquis*, takes over. The countryside is green and full of bright bloom in spring but brown and lifeless in summer.

The People's Achievements in the Peninsulas

This region has a history of long settlement. The Mediterranean region was one of the cradles of civilization. Its mild climate was favorable to primitive man before he knew how to create sound housing and

warm clothing The calm island studded sea provided a good school of navigation People learned to grow enough food in sheltered valleys to afford leisure to advance in arts, crafts science and government Sea trade and conquest allowed first Greece and then Rome to dominate the known world

Today the peninsulas contain centers of dense population though their resources are not so well suited to an industrial civilization as are those of western Europe They lack coal, and few minerals are abundant Spain's dry uplands hold mercury pyrites copper iron lead, and zinc Mediterranean France is a leading source of bauxite Sicily produces sulphur and Italy mercury Waterfalls provide power

Though the Po Valley is the only broad agricultural lowland most people around the Mediterranean make a living by farming They terrace the mountain slopes to hold back erosion and to afford level areas for cultivation Here they grow grapevines citrus and other fruits olives, vegetables and sometimes grain Wheat is the leading grain on valley lands and gentle slopes In the drier sections irrigation is necessary On irrigated lands in southern Spain subtropical crops such as dates, sugar cane, and cotton as well as citrus fruit are grown Sheep and goats are more numerous than cattle on the scanty pasture

Alluvial lands near the mouths of mountain streams are swampy and infested by malarial mosquitoes when drainage has been blocked by sediment The people prefer higher lands to these malarious spots Where governments have drained such areas as the Roman Campagna, prosperous farming settlements occupy them Fine volcanic soils are found around Mount Vesuvius in Italy and Mount Etna in Sicily

Life in the High Ranges

The mountains are not an easy place in which to earn a living Some areas are uninhabited because they are too steep rocky and hard to reach In others stock grazing and lumbering are possible In good valleys the farmers raise hardy vegetables and grains as well as hay for their stock They drive their dairy cattle to Alpine meadows in summer Sheltered south ward facing slopes bear grapevines

The enterprising Swiss have been able to turn their mountainous country into a great manufacturing region Their advantages over other mountainous lands include their location in the heart of western Europe and the broad relatively level plateau where their chief cities and farms lie Hydroelectricity from the mountain streams supplies power for factories and railways Since the Swiss and Austrian Alps lie across main routes of travel roads through their passes have existed throughout history

Scenic grandeur is one of the resources of the Alpine system The front ranges have rounded peaks and U-shaped valleys cut by Ice Age glaciers Blue lakes sparkle against the somber green of the pine forests Further into the heart of the mountains narrow stony valleys thread between steep slopes and sharp peaks Glaciers push down the slopes from lofty snow fields People of the mountain lands have built hotels roads scenic railways ski runs and other facilities to entertain visitors

The eastern ranges of the mountains are lower (except for the Caucasus) but rugged and inhospitable except for their interior basins In the large fertile Hungarian and Rumanian basins the farmers raise large crops of wheat and corn and fatten livestock

The high Caucasus range rising between Europe and the Near East has an Asiatic population Its loftiest peak Mount Elbrus 18 481 feet is Europe s highest Though the scenery here resembles that of the Alps the mountains lack the convenient passes The railway lines follow the shore of the Caspian Sea

The Thrilling Panorama of Europe's History

TWENTY FIVE thousand years ago at the close of the last "Ice Age' or glacial epoch primitive man had already marked Europe for his own From the caves of France, Spain Germany and elsewhere over wooden villages set on piles driven into lake or river bottoms from southern Sweden and Switzerland to the heel of Italy and the Black Sea—the smoke of his campfires floated over the forests With inconceivable slowness and pain he rose from savagery to barbarism More advanced civilization began about 2 500 years B C to come from Egypt and Asia by way of the islands of the Aegean Sea In course of time this flowered into the splendors of Greek and Roman culture With these two peoples there begins the recorded history of Europe as opposed to our dim glimpses into its prehistoric past (*See also* Civilization, Man Aegean Civilization, Greece, Roman History, World History)

The Germans Invade the Roman Empire

On the death of Theodosius the Great (A D 395) the Roman Empire was divided finally into two parts—the Western Empire with Rome as its capital and the Eastern Empire (also called Greek or Byzantine Empire) the capital of which was at Constantinople (*see* Byzantine Empire) Beyond the boundaries of the Roman world were numerous barbaric peoples divided into three main groups (1) remnants of the great Celtic stock in outlying parts of the British Isles (2) Germans or Teutonic folk lying along the Rhine and Danube rivers and in the Scandinavian Peninsula and (3) the great mass of the Slavs ancestors of our modern Poles Russians Czechs Serbians and others whose tribes even then lay eastward of the Teutons

The German barbarians were divided chiefly into Goths Burgundians Vandals Alemannians Bavarians Langobards (Lombards) Franks Angles Saxons and Frisians The Gothic tribes (Visigoths and Ostrogoths) had been established along the shores of the lower Danube and the Black Sea for nearly 200 years This region was invaded by the Huns from Central Asia and its inhabitants pushed westward causing

the great Gothic invasion (375 A.D.). Gaul was overrun chiefly by Visigoths, Burgundians, and Franks; Spain by Vandals, Suevi, and Visigoths; Africa by Vandals, crossing from Spain. Italy suffered a number of invasions, especially those of the Visigoths, Ostrogoths, and Lombards; Britain, after being abandoned by its Roman garrison (410 A.D.), became a prey to Angles and Saxons sailing in their piratical vessels from their homes about the mouth of the river Elbe. But the influence of Rome—its language, law, and government—left a stamp which has never yet wholly been effaced.

It was the task of Charlemagne (768–814), building on the foundations laid by the Frankish kings who preceded him, to consolidate the Germanic conquests into an empire which stretched from the Ebro River in Spain to beyond the Elbe, and from the North Sea to a little south of Rome in Italy. The decline of classical civilization was checked; something of the Roman tradition of unity, order, and centralization was preserved in the face of advancing feudalism; and Christianity was spread through most of Western Europe (*see* Charlemagne). But Mohammedanism, established in Spain since 711, lingered in that land until the Moors were finally conquered in 1492.

Rise of Modern States

The division of the Frankish empire in the Partition of Verdun (843) became the starting point of the kingdoms and nations of France and Germany. Under Otto I, king of Germany, 936 to 973, the empire in the West was a second time revived, under the title "Holy Roman Empire." But it now included only Germany and Italy and its power grew ever less until its extinction in 1806. The Eastern Empire, in spite of many vicissitudes, fulfilled its function as a bulwark against Asiatic conquest and Mohammedanism until it was overwhelmed by the Ottoman Turks (fall of Constantinople, 1453). Where Hungary now is dwelt the Asiatic Avars, whose place was taken in the 10th century by their kindred the modern Magyars. Nothing but the little kingdom of Asturias was left of the Gothic power in Spain; but from this seed grew the Christian realms of Castile, Leon, and Aragon, which were consolidated in the 15th century into the kingdom of "their Catholic Majesties," the sovereigns of Spain.

The viking Northmen, after raiding from their Scandinavian homes the coasts of all western Europe in the 9th century, settled in western France in 911; then as "Normans" they founded the kingdom of Naples and Sicily in Italy, and gave a new dynasty to England (1066). Their descendant on the female side, Henry II of Anjou, was king of England, lord of Ireland, and feudal holder of Normandy, Anjou, Brittany, and Aquitaine in France. Only gradually were the Capetian kings of France able to reconstitute the unity of their kingdom and set it on that path of internal growth which made it under Louis XI, 1461 to 1483, the first strong monarchical state of modern times. Meanwhile the "States of the Church" were established in Italy as the temporal dominion of the pope; Poland and Russia became settled Christian states; the heathen Prussians were christianized and Germanized by the Order of Teutonic Knights; feudalism, Christianity, monasticism, and medieval art and learning spread everywhere, and the Crusades, the growth of town life, and reviving commerce prepared the way for that rebirth of the human spirit which we call the Renaissance (*see* Crusades; Renaissance).

Wars of Religion and Conquest

The expedition of Charles VIII of France, in 1494, to assert his claim to inherit the kingdom of Naples and Sicily started a series of wars over Italy which embroiled France and Spain for half a century and enabled the Reformation started by Luther to get such a spread that it could not be stamped out. The close of the conflict left the Emperor Charles V not only ruler of united Spain and Germany, but also of Sardinia, Sicily and Naples, Milan, the Netherlands, the county of Burgundy (Franche Comté), and a great part of the New World. His brother Ferdinand I, archduke of Austria and emperor and head of the German branch of the Hapsburgs after Charles, obtained by marriage Silesia, Bohemia, and that part of Hungary which had not fallen into the hands of the victorious Turks. The power of the Spanish Hapsburgs, under Charles' son, Philip II, and his successors, steadily declined.

The close of the Thirty Years' War (1618–1648)—the last of the wars of religion—left the Holy Roman Empire greatly weakened and practically confined to Germany and Austria. France became again the first power of Europe, having obtained much of the Burgundian lands (including Franche Comté, conquered by Louis XIV, 1643–1715). Savoy, straddling the French Alps, was becoming an Italian power. Spain still held the Spanish Netherlands (Belgium) and a great part of Italy. The Protestant Netherlands (Holland) and Switzerland had freed themselves by successful revolt from the Empire. Sweden, independent of Denmark since 1523, was one of the great powers, having conquered territories alike from Germany, Poland, and Russia. Denmark still ruled Norway. The duchy of Prussia, united to the mark of Brandenburg in 1618, was soon (1701) to give its name to a new German kingdom erected by the military power of the Hohenzollerns.

Shifting Fortunes of the Nations

In the 16th century Poland (in union with Lithuania since 1569) was one of the most powerful states of Europe, stretching from the Baltic almost to the Black Sea; but the 18th century saw its steady decline. Russia, under Peter the Great (1689–1725) and Catherine II (1766–96), became a formidable and disquieting power. Turkey, though decreased since its high-water mark of conquest in the 17th century, still retained the greater part of the former Eastern Empire. Venice held an extensive sway in the Adriatic and the Eastern Mediterranean; and Genoa held Corsica until it passed to France in 1768.

Soon after the outbreak of the French Revolution (1789) Poland ceased to exist through partition by its greedy neighbors. Prussia had risen to the rank of a great power following the wars of Frederick the Great. Sweden had lost the leadership of Northern Europe. The Spanish Netherlands had passed to Austria in 1713 at the close of the War of the Spanish Succession; and branches of the French house of Bourbon ruled the parts of Italy that had been Spanish as well as Spain itself. England had become the head of a British Empire and had originated the inventions which led to the Industrial Revolution, a change quite as important in its way as the French Revolution. As the Mother of Parliaments it was the model to the world of constitutional government and political liberty during the first half of the 19th century.

The French Revolution and After

The wars of the French Revolution (*see* French Revolution) began a series of changes that ended in the extension of Napoleon's direct empire over Germany west of the Rhine, the Netherlands, northwestern Germany, and a great part of Italy and Dalmatia. In addition his brother Joseph was king of Spain, his brother-in-law Murat sat on the throne of Naples, and the grand duchy of Warsaw and the Confederation of the Rhine were under rulers he chose. After the fall of Napoleon at Waterloo the Congress of Vienna forced France to retire within its old limits and in large part restored the old government. But Russia was allowed to annex Finland from Sweden and increase its Polish territories by absorbing the grand duchy of Warsaw. Prussia was enlarged at the expense of Saxony and by annexations on the west bank of the Rhine. Austria was given northern Italy in exchange for Belgium, which was united in unstable union with Holland until 1830. Norway was torn from Denmark and given to Sweden, with which it remained united until 1905. The states of Germany (now reduced from several hundred to 38, including Austria and Prussia) were organized into a loose union called the German Confederation, to replace the Holy Roman Empire, which had now disappeared.

The Holy Alliance and the Grand Alliance

In 1815 Czar Alexander I of Russia drafted a vague treaty called the Holy Alliance pledging the monarchs of Europe to take for their rule of conduct only the Christian religion. More effective was the Grand or Quadruple Alliance formed in the same year by Austria, Prussia, Russia and Great Britain. (France was later admitted.) This had the purpose of preserving legitimate (meaning hereditary) government and the terms of the Vienna settlement. This group of states dominated the Concert of Europe, the system whereby no important change might take place without the consent of these Great Powers. An accompanying principle, the *balance of power*, required that no one of the Great Powers should become strong enough to dominate the others. It was this principle which France had violated under Napoleon and which the Concert of Europe reestablished.

Industrial Revolution and Growing Nationalism

But no pressure of the Great Powers could permanently block change. The intense nationalism and hatred of absolute monarchs developed in France by the Revolution had spread throughout Europe. The development of the steam engine made factories and railroads possible and created a new class of industrial rich who resented the control of the landed nobility and demanded that governments protect the development of industry and keep out foreign goods. The new class of factory workers followed its employers and opposed the old nobility.

Yet for 30 years under the leadership of Metternich of Austria the Great Powers preserved much of the Vienna settlement. In 1830 Belgium broke away from the Netherlands in the name of nationalism, and France replaced its absolutist Bourbon king by a monarchy more favorable to business under Louis Philippe. But the Concert broke a democratic revolt in Spain, and Russia put down a nationalist revolt in Poland. In 1848, however, a worse storm broke and Metternich himself fled. In that year and the following one a temporary republic was established in France, the King of Prussia and the Austrian Emperor were forced to grant constitutions, and Hungary and northern Italy revolted against Austria. Again reaction triumphed. France submitted to the dictatorship of Napoleon III. The Frankfort Assembly, composed largely of intellectuals, failed to prepare an acceptable German constitution and was disbanded. Austria suppressed the Hungarian rebellion with Russia's help and reconquered its Italian provinces.

But now for half a century nationalism developed—the political union of people with common racial, territorial or emotional attachments—and swept away much of the Vienna system. France under Napoleon III helped the kingdom of Sardinia free the rest of Italy and unite it into one kingdom. Bismarck, prime minister of Prussia, undertook three wars which drove Austria out of the German Confederation and united the rest of the Germans in the German Empire under the hereditary rule of the king of Prussia. The Turkish Empire in Europe gradually fell apart, and the Concert of Europe supervised the establishment of the small nations as they broke away—the Christian Balkan states of Greece, Serbia, Bulgaria and Rumania. When Russia attempted to intervene independently in Turkey in 1853 the ensuing Crimean War forced Russia to submit to a settlement by the Concert.

The principle of nationalism was sometimes violated. Bismarck after the Franco-Prussian War annexed Alsace-Lorraine with a largely French population because German industry needed the iron and potash of that region. In 1867 after its defeat by Prussia, Austria formed the dual monarchy of Austria-Hungary, making the people of a number of nationalities subject to these two. Economically, however, this empire was a sound arrangement, because the farm products of one part could be exchanged for the

industrial products of another. Meantime, while the poorer classes were becoming more dependent economically on industrial owners, they were gaining political freedom. In 1815, Great Britain was still largely controlled by a few land-owning families. Beginning with 1837, the right to vote was given to progressively larger bodies of citizens, until by the time of the first World War it was possessed by practically all adult males, and in 1911 the House of Lords lost its power to veto laws voted by the more democratic House of Commons. In 1870 Napoleon III was driven from the French throne and a republic was set up. In Spain a revolt in 1868 against the despotic Queen Isabella succeeded, but the new democratic government failed to find another sovereign. Italy in the process of unification drove out the absolute monarchs formerly in control, substituting the democratic monarchs of the House of Savoy. The Scandinavian states, the Netherlands, and Belgium lived under monarchs with strictly limited powers.

Colonies and Alliances

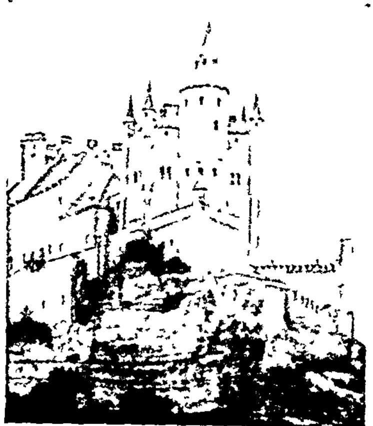
In the latter part of the century the factories of the Great Powers were able to produce more than they could sell at home, and they also needed raw materials produced elsewhere. So they pushed their governments to seek colonies abroad rather than fight one another for European markets. Great Britain, France, and Germany conquered great colonial empires in Asia and Africa, and Russia spread all the way across northern Asia. These empires came into contact, and friction developed. The powers then developed markets in the smaller European states, with the same result.

From this situation developed an armament race and systems of alliances which eventually broke up the Concert. Russia initiated two conferences at the Hague in 1899 and 1907 to check the armament race, but these resulted only in setting up a court of arbitration which the states were not obliged to use (*see* Arbitration) and in establishing rules for war which were broken in 1914. Armaments increased faster than ever, and each state grew closer to its allies. Germany and Austria-Hungary, fearing Russia, formed an alliance. France and Russia, fearing Germany, did likewise. Italy, piqued at France, who blocked its African expansion, joined Germany and Austria in the Triple Alliance, but wavered when France made concessions. Great Britain, though preferring to avoid continental alliances, feared Germany's growing navy and so supported France and entered into the Triple Entente with France and Russia.

The Balkan Wars and the First World War

In 1912, against the wishes of the Concert, the Balkan States went to war to capture the Turkish territory inhabited by their nationals (*see* Balkan Peninsula). Serbia, exulting in the ensuing victory, started propaganda for annexing Bosnia and Herzegovina, part of Austria-Hungary inhabited by Serbs. The assassination of Francis Ferdinand, Austrian crown prince, in the Bosnian capital of Sarajevo, June 28, 1914, was a result of this propaganda. Austria's determination to crush Serbia brought Russia, as protector of the Slav states, to Serbia's side. The two systems of alliances then engulfed all Europe in the first World War (*see* World War, First).

A CASTLE IN SPAIN



Perched high on a crag, the Alcazar of Segovia looks over the Spanish countryside. The city of Segovia lies behind the castle.

Changes After the First World War

The changes in Europe resulting from the war were far-reaching. Old boundaries and political institutions disappeared, social classes rose or fell, and perplexing new economic problems appeared. The czar of Russia was killed and replaced by a proletarian soviet system, under the dictator Lenin. The emperors of Germany and Austria were dethroned, and republics were established. The Ottoman sultan was replaced by Mustapha Kemal, an army-supported dictator. Farmer revolts in eastern Europe broke up the great estates into small farms, and reduced the old agricultural nobility. Labor received new rights. England, Germany, Russia, and Poland gave women the vote. Subject races broke Austria-Hungary apart and tore pieces from western Russia. The inhabitants joined their racial brothers across the frontiers or set up new states.

Every government had spent recklessly during the war and was hopelessly in debt. War taxes, property destruction estimated at 90 billion dollars, and the death of the family wage earners had impoverished the people. Insolvent governments issued paper money, which in Germany and elsewhere lost all value and ruined those living on savings.

The Peace Treaties

The Paris Peace Conference attempted the task of reconstruction, through a series of separate treaties with the defeated states. The hope that the Concert of Europe might be replaced by a democratic League of Nations, where all states would be represented, was embodied in the Covenant of the League which was included in all the treaties. (*See* League of Nations.)

Otherwise the treaties embodied all the war's fears and hatreds. The Treaty of Versailles with Germany returned Alsace-Lorraine to France, took away Germany's colonies, disarmed Germany on land and sea and in the air, and forced it to make undetermined reparations payments for war damages.

The other defeated states were also disarmed. The treaties of Saint-Germain with Austria and Trianon with Hungary were supposedly based on the principle of nationalism. Czechoslovakia and Poland were cre-

ated and Yugoslavia, Rumania and Italy all received parts of the old Austro-Hungarian Empire. Bulgaria lost much territory through the Neuilly Treaty. The Ottoman Empire was almost completely dismembered by the Treaty of Sèvres, but Mustapha Kemal revolted and forced more favorable terms in the Treaty of Lausanne in 1923.

The Great Powers recognized by treaties the independence of the new nations carved from Russia—Finland, Latvia, Lithuania and Estonia—and of Poland, which was restored from fragments of Germany, Austria and Russia.

Measures to Promote Peace

It was hoped that the new League system would later remedy the injustices of the peace settlement and meet new political problems as they arose. In 1921 the Permanent Court of International Justice was set up at the Hague to settle legal disputes and to give opinions requested by the League. The League itself brought about peaceful arbitration of several quarrels between nations. In 1925 the major powers signed the Locarno Pact, agreeing to maintain their existing frontiers and reaffirming their willingness to submit all disputes to the League. In the Kellogg-Briand Pact of 1928 they further agreed to renounce war as an instrument of national policy. Along with these pledges to maintain peace came widespread reduction in armaments. Conferences to limit naval construction were held in 1921-22 and in 1930 (*see* Navy) and in 1932 a general disarmament conference attended by delegates of 59 nations was held in Geneva.

With such promise of lasting peace, Europe began to rebuild. From 1924 to 1929 business improved and paper money was again given definite value. American citizens lent billions to Europe's states and cities for reconstruction. Huge programs were undertaken to build homes for workmen, who attained new prosperity with improved industrial conditions and co-operative stores. Socialist parties became strong enough in Great Britain, France and a number of smaller states to share in the government.

If Europe had not quickly resorted to its prewar political habits, this prosperity might have lasted. But a Concert of victorious powers, often ignoring the League, replaced the old Concert and kept Russia and Germany out. No great state would consider surrendering any part of its sovereign right to act unchecked in important matters. The political activity of the League was thus largely reduced to maintaining the superiority of the victorious states.

France, always fearful of Germany, alternately placated and repressed it. Soon after the war France helped to organize the Little Entente—Czechoslovakia, Rumania and Yugoslavia—who also were bent on maintaining the Paris peace settlement. France formed alliances with them and with Poland, who had equal cause to fear Germany. With the German default on reparation payments in 1922, however, France felt strong enough to act alone. It seized the important Ruhr Valley, but then agreed to a reparation settlement (the Dawes Plan), which in turn was replaced by the Young Plan in 1929, granting more lenient terms. In 1925 Briand of France and Stresemann of Germany agreed on behalf of their states to respect their common frontiers and to maintain the demilitarized zone in the Rhineland. They secured a guarantee from Great Britain and Italy of this settlement (the Locarno treaties), and Germany was then admitted to the League. But France insisted on keeping Germany disarmed, and the Little Entente applied similar pressure to Austria, Hungary and Bulgaria.

Economic crises rocked the nations of Europe after the war. Those that had long enjoyed democratic parliamentary government surmounted these crises without resorting to a change in their political system. Other countries reverted to arbitrary one-man rule. The first nation to be brought under the rule of a dictator was Russia, where the Communists seized power in 1917. In 1922 Mussolini made himself master of Italy, and in 1933 Hitler became the leader of the German people. Poland, Austria, Spain and some of the Balkan States also abandoned parliamentary government. In most of these countries free enterprise was supplanted by socialistic government control, free speech by unremitting propaganda. Mussolini and Hitler diverted the entire resources of their nations to building up military power and flouted international law. (*See* Dictatorship; Fascism.)

After Hitler's rise to power in 1933 Germany and Italy, at first individually and then together, began to upset the political structure that had grown out of the first World War. This structure—based on the power of the democracies working through the League—was repugnant to Hitler and Mussolini. The two dictators regarded their nations as the "have nots" wronged by the Versailles Treaty. France and England were the "haves," interested in maintaining the *status quo* because it worked to their advantage.

So Hitler in 1933 announced Germany's withdrawal from the League. He then threw off the restrictions of the peace treaty by rebuilding Germany's army, navy and air force. Italy followed the German lead by invading Ethiopia (*see* Ethiopia). And as Mussolini's forces, despite League sanctions, neared their final victory, Hitler in March 1936, again defying the treaty, sent troops into the Rhineland.

Rome-Berlin Axis Defies the Democracies

In October 1936 Italy and Germany announced an agreement to support their parallel interests. This accord, known as the Rome-Berlin Axis, was later widened by the inclusion of Japan in an anti-Comintern pact. Although ostensibly directed against Soviet Russia and communism everywhere in the world, the pact was employed specifically as a threat against the democracies. Thus when the Spanish civil war broke out, Italy and Germany aided the rebels on the ground that they were helping to fight communism, but the immediate result was further to undermine French and British power.

With Italy checking France, Japan menacing Russia and Germany forcing concessions from the nations of central Europe, the strong strategic position

EUROPE'S CITIES BLASTED BY THE FURY OF WAR

Scores of Europe's cities went down in ruins in the second World War. Poland and Russia, Italy and France, Austria and Hungary, the Low Countries, Czechoslovakia, and the Balkan States will long bear the scars of bombing; but in no country will the task of rebuilding be greater than in Germany. Here we see a wrecked district in picturesque Nuremberg. Famous for its beautiful medieval buildings, Nuremberg was also an important center for German heavy industry.

of the anti-Comintern alliance was evident. France was divided by internal strife (*see* France), and England was unprepared for a war in which she might have to defend herself at home, in the Mediterranean, and in the Far East. In 1937, therefore, France and England announced a joint willingness to satisfy the "legitimate grievances" of Germany and Italy.

Hitler Takes Austria and Czechoslovakia

Hitler then began his conquests. In March 1938 he occupied Austria and annexed it to Germany (*see* Austria). Next, he demanded German-speaking Sudetenland from Czechoslovakia. By threatening war, he forced England and France at a conference in Munich in September 1938 to permit him to seize the Sudetenland (*see* Czechoslovakia). Russia then asserted that its offer to aid Czechoslovakia had been refused by France and England, and protested that they were trying to turn Hitler's aggression toward the Soviet Union. Taking advantage of the discord, Hitler in March 1939 took most of the rest of Czechoslovakia. Hungary, now in the anti-Comintern pact, and Poland took the rest. Meanwhile Hitler had revived Germany's old ambition to drive to the east (*Drang nach Osten*) by extending German economic power into the Balkans (*see* Balkan Peninsula).

The Axis Helps Franco to Win Spain

The continued armed intervention by Germany and Italy in Spain helped the rebels to defeat the loyalists. Gen. Francisco Franco seized Madrid on March 28, 1939. Franco then established a fascist dictatorship and joined the anti-Comintern pact (*see* Spain). These Axis triumphs forced England and France to abandon their appeasement policy. In March 1939 they promised to defend the independence of Poland. After Italy seized Albania in April, England and France extended their pledge to Rumania, Greece, and Turkey.

Axis Aggression Brings Second World War

The new system of guarantees divided Europe into armed factions of Axis and anti-Axis nations, with Russia standing aloof. Defying France and England, Hitler demanded Danzig from Poland. When Poland refused, Hitler confounded the democracies by signing a nonaggression pact with Russia. Thus protected in the east, Hitler on Sept. 1, 1939, invaded Poland. On September 3 England and France declared war on Germany. (For military and diplomatic events of the war, *see* World War, Second.)

Aftermath of the Second World War

The war in Europe ended when Germany surrendered on May 7, 1945. The surrender was announced on May 8, which came to be called V-E Day ("Victory in Europe Day"). V-E Day found virtually all Europe in need of help.

Scores of cities lay in ruins. Such great world centers as Vienna, Budapest, Warsaw, Munich, Nuremberg, and Kharkov were almost leveled. Vast areas of London and Rotterdam were bombed into fragments. Whole villages throughout Europe were wiped out. Railways and highways, ports and canals had been

damaged or wholly destroyed Farmers needed seed draft animals, fertilizer, and machinery

Dispirited people of most countries tended to shift the burden to their governments Socialists and Communists vied for political power The Socialists advocated only moderate control over business and social institutions while the Communists aimed at total control Unwilling to sacrifice all self-government Western Europe inclined to moderate socialism Eastern Europe long used to dictatorial rule leaned to Communism *In all nations except Russia Communists* were a political minority But they were well organized and firmly directed by Russia and so they formed powerful dissenting groups

Russia Surges to Power as War Weakens West

The war s end marked the beginning of a new struggle for power on the continent For centuries Austrian or German strength had served as a buffer between Western Europe and the Slavic East The war *destroyed that historic pattern Russia emerged as* the strongest nation on the continent Through its military gains, Russia dominated almost all Eastern Europe from the Baltic Sea to the Adriatic Sea

The war had weakened Western Europe Some nations were under occupation Britain s power was at an ebb France and others suffered political strife

Yet preservation of democratic government on the continent rested chiefly on Western Europe The con*flict of* principles between democratic Western Europe and totalitarian Communist Russia affected efforts to reconstruct Europe and to establish world peace

The Struggle for Peace Begins

Just before the end of the war in 1945 the anti-Axis countries had formed the United Nations (*see* United Nations) Its purpose was to ensure lasting world peace But in the highest agency of the United Nations the Security Council, a decision could be vetoed by any one of the "Big Five" They were *Russia* France, Britain China, and the United States Russia used its veto to block the democracies in actions unfavorable to Soviet policy In this way it prolonged Balkan strife and delayed limiting armaments

Russia set up puppet régimes in nations occupied by Soviet troops—Poland, Hungary, and all the Balkans except Greece, where Britain had a foothold Soviet troops also held eastern Austria and eastern Germany Seizing more than reparations, Russia *virtually* stripped these nations The Communists dealt harshly with liberals and conservatives Elections were controlled behind an "iron curtain" of censorship These satellites upheld Russia in the United Nations

Peace Treaties Bring New Boundaries

In October 1946 delegates from 21 United Nations agreed on peace terms for all Axis nations except Austria, Germany, and Japan On Feb 10, 1947, in Paris *the Allies* signed peace treaties *with* Italy, Rumania, Bulgaria, Hungary, and Finland

The treaties with Rumania and Finland confirmed their losses to Russia during the war From Rumania, Russia had taken Bessarabia and north Bucovina From Finland the Soviet Union acquired the Karelian Isthmus and smaller areas Added to these were *territorial gains from Czechoslovakia, Poland* and East Prussia, and the earlier absorption of the Baltic States into the Soviet Union Russia thus had added some 200 200 square miles to its territory in Europe

Poland too had moved westward into Germany, but the Western powers declared that confirmation of its gains must await the German peace treaty Italy lost the most territory giving up its African colonies the Dodecanese Islands and Trieste Hungary ceded *a bridgehead on the Danube to Czechoslovakia* Bulgaria lost no territory (*see* World War Second)

Communism Divides Europe

The war against Fascism was won But another force threatened Europe and the world That force was Communism It spread from Russia which had trained leaders from other countries When they returned to their native lands they built small but ruthless Communist parties Behind their "iron curtain *the Communists gained control of nearly all central* and eastern Europe

Russia s ambitious goal became increasingly clear The Soviet Union was determined to engulf all Europe in Communism—and then dominate the world Communist elements were still small in the democracies and so Russia sought to strengthen them Knowing that Communism breeds best in economic distress and social unrest Russia strove to prevent the rehabilita*tion of the democracies*

The Soviet Union's first move was to balk writing peace treaties for Austria and Germany This slowed Europe's economic revival, for normal trade depended largely upon the restoration of German industry Russia then sapped weakened Britain s aid *to Greece by* supporting the Greek Communists' guerrilla warfare The Soviet also aided the antinational activities of Communist minorities in Italy, France, and Belgium

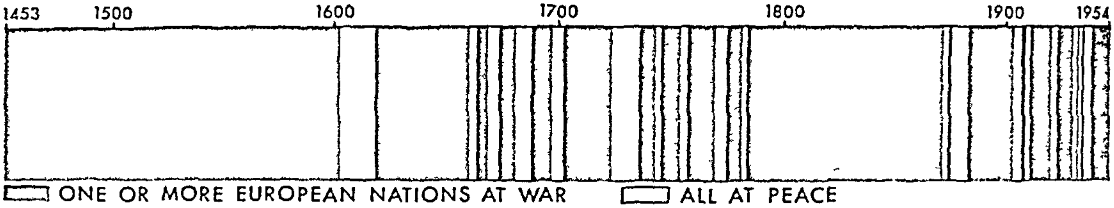
Truman Doctrine and Marshall Plan

After Russia steadily refused to cooperate with the democracies in Europe and in the United Nations the United States abandoned its historic isolation It strove to halt the spread of Communism In 1947, it proclaimed the *Truman Doctrine This was designed to* "contain" Russian expansion It provided financial aid to Greece and Turkey to prevent Russian domination of the Middle East The United States also directed the Greek army's fight against the guerrillas

The United States then proposed a *bold* basic idea for European recovery It was the Marshall Plan The plan indicated that the United States would give economic aid to *all* European nations that jointly worked out a program *for eco*nomic reconstruction

This American aid seemed essential, for the war and its aftermath had drained Europe's economy Italy had lost all its colonies, and Britain, France and the Netherlands had been forced to give up most of their empires This *loss of foreign investment* cut deeply into Europe's balance of trade Tariff walls and other trade barriers within Europe, as well as abroad, hindered commerce Outdated machinery and *industrial* methods kept European products at high

ARMED CONFLICT DOMINATES LAST FIVE CENTURIES IN EUROPE



This graph shows the relative periods of peace and war in Europe from the end of the Hundred Years' War to the year 1954. During the span of 501 years, 337 years found one or more of the European nations at war on the continent or engaged in a struggle overseas to win a new colony or to put down revolt in an existing colony. Few colonies now remain.

cost in the world markets. Modernization was necessary but costly. Yet economic progress was imperative if Europe were to withstand Communism. The Marshall Plan proposed the needed financial aid.

The European democracies voted to accept the plan. But Russia forbade its satellites to take part. It even "persuaded" democratic Czechoslovakia to withdraw its original intention to accept.

Russia promptly undertook to combat the growing influence of the United States. The Russian satellite nations established the Communist Information Bureau, or "Cominform." Its chief duty was to spread propaganda against the United States. Powerful Soviet transmitters also tried to "jam" the Voice of America. This was the international radio broadcast of information by the United States government.

Tension Mounts in 1948

Early in 1948 Russia suddenly extended its domination in Europe. Without warning, Czech Communists seized control of Czechoslovakia in a political coup. Communism had made another strike westward.

This spurred the United States to increase its economic aid to Europe. It put the Marshall Plan into effect as the European Recovery Program. When Italy held a general election, the United States warned that it would withdraw its economic aid if Italians elected a Communist government. They did not.

The restoration of German industry was still vital to Europe's economic recovery. When Russia continued to block a peace treaty for Germany, Britain and the United States moved to revive industry in Western Germany. They merged their zones of occupation into "Bizonia." Later this became "Trizonia," when merged with the area occupied by the French.

Russia Starts the "Cold War"

Russia countered by launching a "cold war." This was not a combat of arms. It was a series of obstructionist acts designed to make the Allies quit Germany. The "cold war" began when Russia threw a land blockade against the Allied sector of Berlin to keep food and supplies from the city. The Allies overcame the blockade with a huge "air lift," with planes bringing in even coal and machinery.

The growing threat of Communism drove the nations of Western Europe to make alliances. In 1947 Belgium, the Netherlands, and Luxemburg had formed a customs union called Benelux. In 1948, at Brussels, the Benelux nations signed a 50-year pact with France and Britain. The treaty pledged co-operation in defense, economic, and cultural affairs. It established the Union of Western Europe. Later the union created the West European Defense Organization.

Meanwhile Russia kept a harsh grip on its satellites. They showed some unrest, but liberals and conservatives were ruthlessly "tried" for "treason" or "black marketing." The clergy was especially harassed in Hungary, Bulgaria, and Czechoslovakia.

Only Yugoslavia openly defied Russia. Marshal Tito kept the Communist form of government, but insisted that Yugoslavia's interests stood ahead of Russia's. He looked to the West for economic pacts.

In 1949 Western Europe moved even closer to collective action against Communism. The Western nations created the Council of Europe. This was an advisory group that worked toward political federation. The council had a "cabinet" called the Committee of Ministers and a consultative assembly. Their headquarters were at Strasbourg, France. This was the first time in history that major European powers had taken even a first step toward federation.

Even more significant was the action taken by the United States for collective defense. The United States proposed a mutual defense pact to the democracies of Western Europe. This was called the North Atlantic Treaty. It was signed by the United States, Canada, and ten European democracies. This was the first time that the United States had made any military alliance with Europe during a period of peace.

Determined to strengthen the economy of Western Europe, the Allies permitted West Germany to set up a republic. Bonn was the capital. Russia countered by creating a puppet East German "republic."

The democracies learned that Russia had achieved the release of atomic energy. The United States then rushed arms to Western Europe. Meanwhile, Eastern Germany organized an armed "police force."

Still fearing Russian aggression, Western Europe in 1951 gave command of its armed forces to Gen. Dwight Eisenhower. He was later succeeded by other Americans. Most European members of the United Nations sent supplies or token forces to aid in the UN fight against the Communist attack in Korea.

NATO and European Defense Community

In 1952 Western Europe took further steps toward collective defense. Leaders meeting at Lisbon set up an ambitious plan for a NATO army, navy, and air force. In Paris, the Benelux nations and Italy, France, and West Germany planned a European De-

fense Community When ratified by all six nations the EDC would raise a common army dressed in a common uniform co-operating with NATO forces

The death of Russia s ruthless dictator Joseph Stalin in 1953 however lessened some of Western Europe s fear of Soviet aggression Facing the heavy cost of increasing armament most of the nations cooled toward NATO and EDC They made little progress in implementing them The democracies were further heartened by signs of unrest in Red-dominated countries—especially in East Germany where workers rioted against the Communist regime

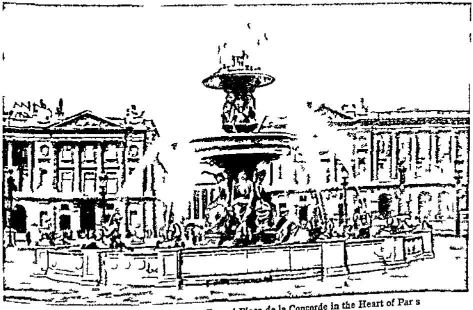
Western Europe also indicated some resentment of the United States The feeling arose chiefly from America s pushing the Korean conflict beyond the 38th parallel and America s insistence on rearming against the threat of Soviet aggression The pro-American governments of Italy and France fell The friendly West German regime of Konrad Adenauer however swept to victory in a general election

The Benelux nations and France West Germany and Italy made a *constructive economic move in 1953* by creating the European Coal and Steel Community The ECSC removed trade bans on their coal and steel

While Western Europe with American help continued to build up strength Russia was weakened by a struggle for power among its new rulers *At the same time it faced an agricultural crisis brought on by the* inefficiency of its collective farm system

On May 5 1955 ten years after the collapse of Germany in World War II West Germany (the Federal German Republic) was formally proclaimed a sovereign nation The British French American occupation regime was ended and the new state was admitted to NATO as the 15th member East Germany remained under Russian domination

Austria also regained its sovereignty in May 1955 Russia finally agreed to a treaty calling for the withdrawing of the occupation armies—Russian French British and American—before the end of the year



An Ornate Fountain Decorates the Famed *Place de la Concorde* in the Heart of Paris

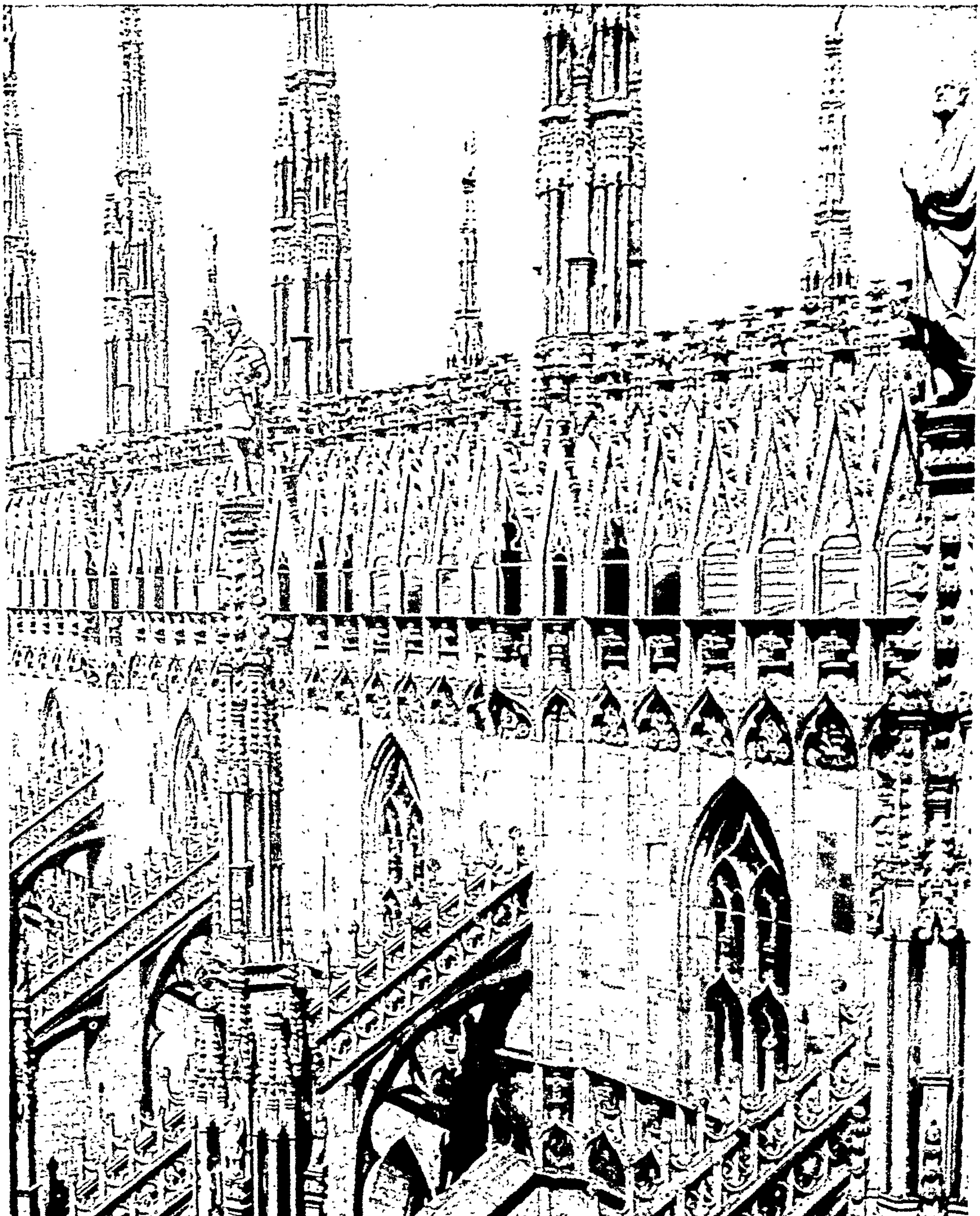
Europe's Superb Treasures of Art and History

EVERY great city of Europe has its own treasure of art masterpieces and historic shrines Most American tourists make every effort to see as many of them as possible

Italy and France are especially rich in their heritage of art and history In Italy we may walk down a street in Florence and admire a work that Michelangelo put there We go through a door in Rome and see art that Raphael created We walk down into the Forum and stand on the spot where according to *tradition* Mark Antony delivered his oration over the assassinated Julius Caesar Near Naples we marvel at the ruins of Pompeii and walk among the gardens and fountains that delighted ancient Roman nobles

In Paris the immensity of the Louvre amazes us This great art museum houses *Titians* Raphaels Egyptian and Assyrian antiquities Greek and Roman sculptures and works of the Middle Ages and Renaissance Above all there are the great Venus de Milo the Victory of Samothrace and the Mona Lisa

Throughout France soar magnificent Gothic cathedrals built piece by piece and carved inch by inch



Nowhere in the world is there on one building a greater wealth of spires and statuary than that which enriches Milan's late 14th century cathedral. Every detail, almost every stone, has been wrought with loving care into a beautiful ornament. This view shows how this ornamentation has been carried out among the "flying buttresses" which support the walls of the cathedral. There are altogether 98 of these spires on the church and more than 4,000 statues.

HOW EUROPE HOUSES ITS PRICELESS ART COLLECTIONS

Th s spac ous vaulted chambe s the Room of Psy he n the Louv e Museum n Pa s In the cente ba kground s ands the incomparab e Venus de Milo The Louvre was once a pa a e of the k ngs of Fran e I s n e o deco s ons efle t the ri h beau y of the Renaissance per od The statues shown in th s p ctu e a e pa t of the Louvre s Museum of An qui es

From century to century man laid up treasure upon earth So arose Notre Dame in Paris

Britain s Great Museum Showcase of Civilization

It is one of the astonish ng experiences of the traveler on h s first visit to Europe to find himself in the British Museum in London It records the chapters of man s life There the visitor strides among the weapons of primitive man repl cas of the tombs of the pharaohs of ancient Egypt And we may see stern sculptures of the Roman emperors and many other Roman and Greek art treasures We may look at the Magna Carta There too is a letter from a k ng of Babylon—and one from George Washington We also find treasures of the Bronze Age when men first found the way to work in metal We can even touch su h things as Abraham and Isaac and Jacob must have used far back in Biblical days

The Old World and Its Memories of the Past

Wherever we go in the Old World cit es we find the memory of the past There are places in wh ch we seem to live the years gone by—such as that quaint old printer s shop in Antwerp which remains to th s day as the printer left it three centuries ago or that merchant s house n Bergen which s hardly altered since the merchants of the Hanseatic League con ducted the r business there

So t is everywhere The streets of the great c t es have many a touch of the human genius of the past especially in Rome and Athens In Athens arose the Parthenon to crown the Acropolis The columned Parthenon has been called the most perfect memorial of anc ent art But the exigenc es of war d d not spare this anc ent glory The Turkish army stored its powder in the Parthenon and an officer in the opposing army of Venet ans fired a shell which broke in two the architectural pride of Athens and the crowning splendor of the most famous hill in the history of c viliza on From Rome comes the tale of the pope who tore the lead roof from the Pantheon to make cannon balls It is the oldest bu ld ng in

the world that still stands as it was the day the builders left it. It dates from Augustus Caesar.

What a glorious place is the center of the treasures of Rome, the Vatican. Here, for all the world to see, Michelangelo left his noblest work. Here Raphael crowded spacious walls with his immortal figures. The Vatican seems a sort of marble forest, so enormous are the distances under its roofs. The largest palace in the world, it covers 13½ acres and is divided into 1,400 chapels and other rooms. Most of them are picture galleries and museums. It would take days to see, and a lifetime to know, their magnificent collections of antiquities, the largest in existence. There are celebrated Raphael paintings, ancient maps and manuscripts, Egyptian mummies, and countless works of art. In Rome is the beautiful tomb of St. Helena, made from one immense block of porphyry, with the triumph of Helena's son Constantine carved upon it. It has been in Rome 750 years, and lay in fragments in a cloister from 1600 to 1750. But somebody cared enough for this stately tomb to have it carefully restored.

Our Rich Inheritance of Art

Who can travel through Europe and look on all these things of beauty and not be grateful to all these countless artists of the past, thousands of them poor and unknown men, who left us this inspired work of their skilled hands?

They have built windows of transparent stone. They have made wondrous cathedral gates like the gates of Ghiberti. They have translated into marble the joy and praise of the Psalms of David, as in the singing choir of Luca della Robbia. They have given us quiet cloisters in cities, where man can put off the stress and strain of the working days, and walk as in spirit.

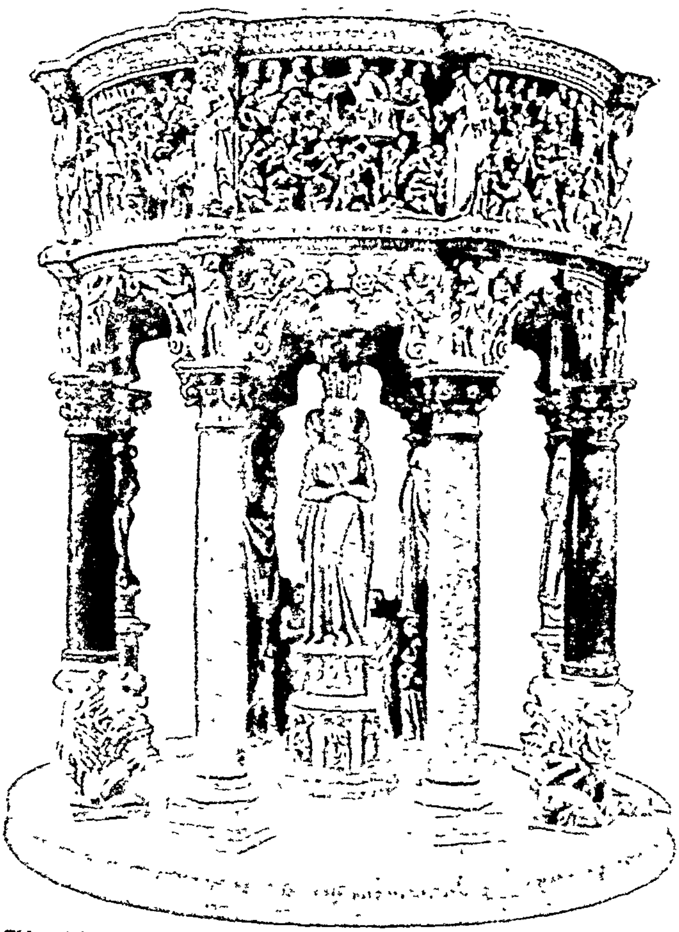
A Charm That Never Grows Old

And what amazes us most of all, perhaps, is that these great beautiful things, often of astonishing strength and gigantic size, have a delicacy of touch and a wondrous charm, and seem as fresh as if they had left the sculptor's studio yesterday. Yet we know that all these things are ages old, and there comes to us, as we look at them, a sense of the continuity of the world. We feel too the intrinsic brotherhood of man.

One generation goes and another comes, and the work of each lives on. One man thinks a beautiful thing. He writes of it or plans it. Then later his thoughts and ideals move the hearts and help to shape the minds of other men.

Wonderful it is that so much of the ancient world remains, and wonderful indeed that so much remains with its charm unspoiled. We must thank the earth itself for most of it, for the kindly soil has covered up our treasures with the dust of centuries. It guarded them from the Goths and the Huns, from time and from weather. We can scarcely conceive the wealth of treasure that the toil of men has stored up for us. The great European museums are literally filled with treasures of beauty and wonders of antiquity far older than the United States. In Amsterdam's State Museum is Rembrandt's 'Night Watch'. The superb 'Venus de Milo' stands in the Louvre in Paris. The Museum of the Prado in Madrid is second only to the Louvre. As we tour the galleries of Europe's magnificent museums, we seem to be journeying through vivid pages

ONE OF ITALY'S RICHEST GEMS

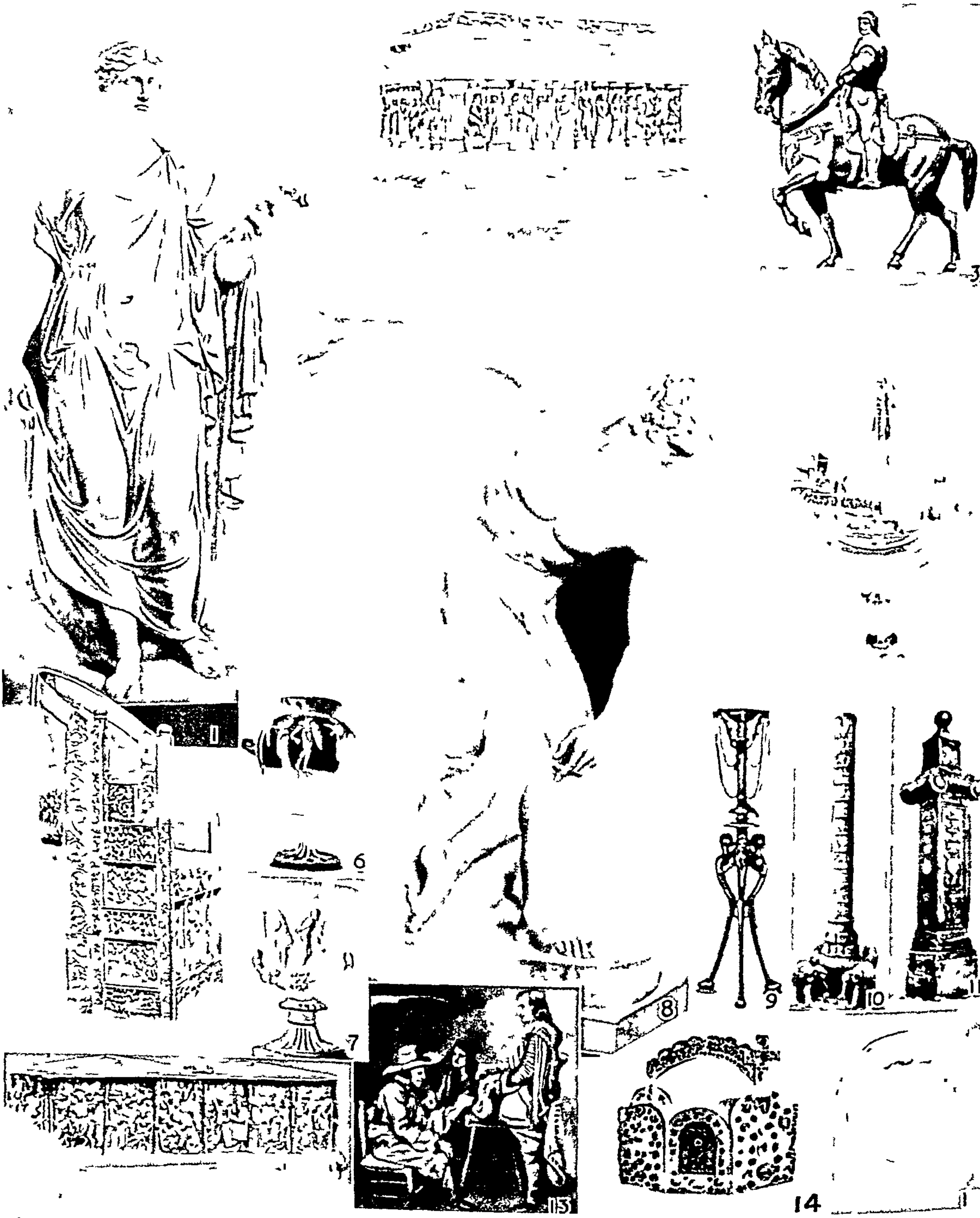


This pulpit, which was made by Giovanni Pisano for the Cathedral at Pisa about 1310, is one of the triumphs of early Italian Renaissance sculpture. During the rebuilding of the Cathedral after the fire of 1595 the pulpit was broken up. Three-quarters of a century ago a devoted art-lover studied the surviving fragments and made from them a model of the original. At the end of the first World War it was decided to reconstruct this magnificent monument. After years of patient labor, the restoration was completed in 1926, and Giovanni Pisano's masterpiece again adorns—after a lapse of three centuries—the Cathedral for which it was built.

ARISTOCRATS OF ART IN THE LOUVRE

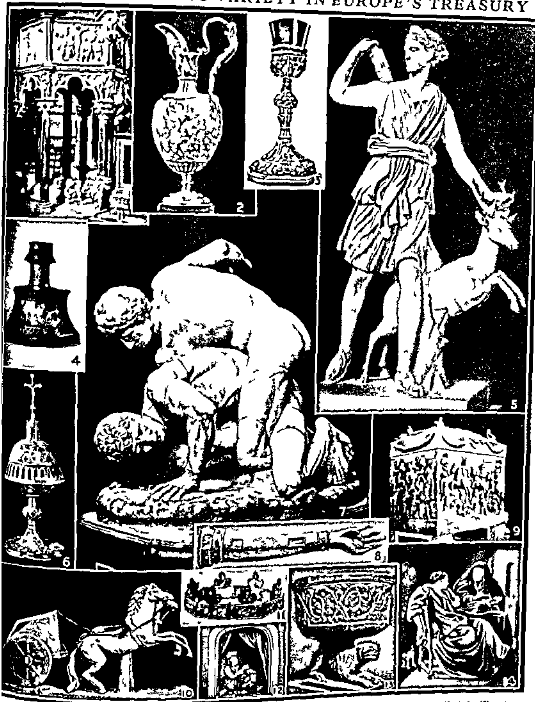
The Louvre in Paris once the palace of French kings possesses one of the greatest collections of art treasures in the world The central view (4) shows the north facade where the Louvre faces the Tuileries gardens The other pictures show a few of the more celebrated treasures (1) Elizabeth Vigée Lebrun's portrait of herself and daughter (2 ancient mirror (3) ancient statue the Artemis of Gabii (5) Venus de Milo (6) Borghese vase (7) La Gioconda or Mona Lisa by Leonardo da Vinci.

EXAMPLES OF THE MAGIC OF THE ARTIST'S SKILL



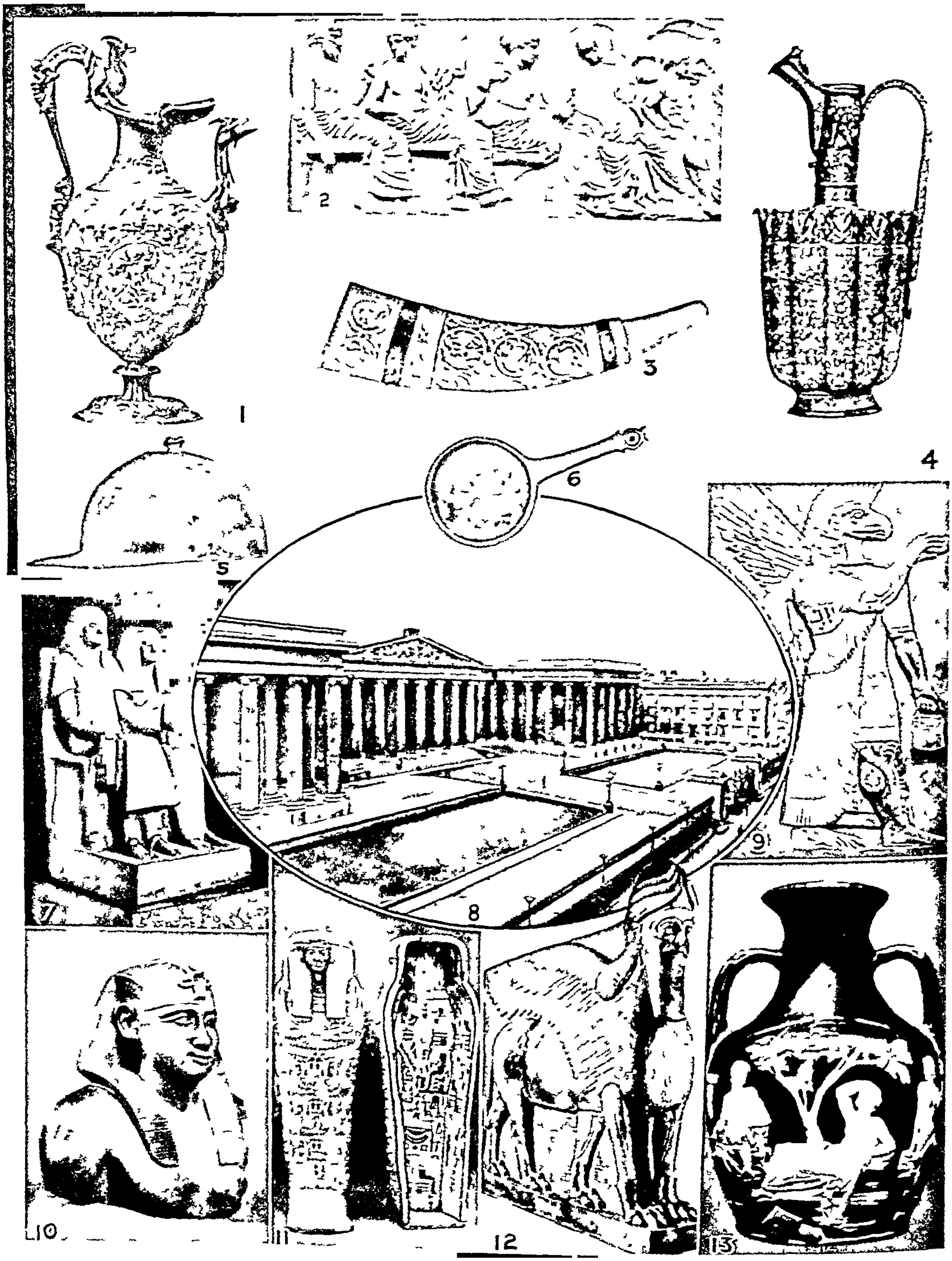
Although all Europe is a storehouse of beautiful objects, Italy is by far the most munificently provided. This is why the examples shown above include more works from Italy than from any other country. The objects are as follows: (1) Greek statue of the goddess Flora, in the National Museum, Naples; (2) ivory casket, Catania; (3) equestrian statue of Captain Colleoni, by Verrocchio, Venice; (4) censer, Church of St Anthony, Padua, (5) ivory chair, Ravenna cathedral, (6) ancient vase, Naples; (7) vase, Florence; (8) 'Discus Thrower', Vatican, Rome; (9) and (10) candlesticks; (11) column; (12) beautifully carved casket, Milan; (13) painting, 'The Order', by Metsu, Dresden Art Gallery; (14) crown of Holy Roman Empire, 14th century; (15) door knocker recovered from the ruins of ancient Pompeii.

FROM THE ENDLESS VARIETY IN EUROPE'S TREASURY



) Pulp t in Baptistery at P sa by N ccolo Pisano (2) silver p tcher by Benvenuto Cellini (3) silver vase (4) old candlestick (5) statue Diana in the Louvre Paris (6) reliquary C v dale (7) Greek statuary group The Wrestlers Florence (8) jeweled arm and hand of tal, Catania (9) sarcophagus of Empress Helena in Rome, (10) Roman chariot Vatican Rome 11 crown of the 13th century Namur hedral, Belgium (12) painting The Dentist by Gerard *Dow* Dresden Art Gallery (13 font at Parma (14) paint ng The Fortune eller' M eris, Dresden Art Gallery The Italian eminence in art is easy to understand. *Italy* was heir of the Roman and Greek c vili-zations and was also the b rthplace of the Renaissance so she has had the longest period in which to acquire treasures.

SOME OF ENGLAND'S RELICS OF BYGONE CENTURIES



Here are a few of the interesting objects in the British Museum, shown in the center picture (8). The ewer (1) showing Neptune and Amphitrite is 16th century Flemish work, while the portion of the Parthenon frieze (2) is among the most highly prized exhibits The ivory horn (3) and the metal-work ewer from Mesopotamia (4) are of the 10th and 13th centuries, while the Roman helmet (5) and cooking utensil (6) are much older. But oldest of all are the Egyptian and Assyrian exhibits—statues of an Egyptian official and his wife (7), a winged god (9), the head of Ptolemy Auletes (10), the coffin of the priestess Ta-Ahti (11), and the Assyrian winged bull (12). The Portland vase (13), the most famous vase in the world, is from the time of St. Paul.

of a history book We can go for a walk *through history* and feel very close to Cromwell and Drake and Mary Queen of Scots for we can read letters *they* wrote with their own hands and at Oxford *we can see* a chair made from a piece of the ship in wh ch S r Francis Drake sailed around the *world* We *can see* the things that Socrates and Plato saw we can touch a thing St Paul looked on we *can read the actual* letter written by Anne Boleyn as *her heart was beating* h gh at the thought of marrying the Bluebeard king who later murdered her

The wealth of the museums of Europe is so immense that no *man knows the extent of it* and no gold *can buy it* Treasure piled on treasure meets our gaze wonder on wonder tragedy on tragedy all *the emotions* that come into our lives from the cradle to the grave stir in us as we walk through these great galleries Gems that gl tter like the sun *things* so beautiful that they seem to belong to a world of dreams marvelous products of the patience of Nature and of the immense labor of men s hands *ghastly* s ghts from which we turn away and shudder memories of immortal deeds a touch of the genius of Shakespeare and M chelangelo a little thing King Alfred owned someth ng Cromwell wrote and an actual relic of Napoleon Bonaparte fragments of history from every age and every land types of life from every clime Nature in all her seasons and in all her glory and through all her generations the books that men have written the p ctures they have painted the statues they have carved—all these are here

It is all here for you and me treasure untold that belongs to the world It has come to us from the past to which we owe our priceless heritage it belongs to this generat on of the world to hold in trust and to be handed on to that far-off future which all good men believe will be greater and greater yet

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EVANSVILLE IND In the days of river steamboats Evansville was an important harbor on the Ohio River Today sturdy tugs push barges in and out of its harbor Nearby coal and oil brought factories to Evansville and the city has become a national center for the manufacture of electric refrigeration equipment Other important products are automobile bodies power shovels tools and machinery structural steel foods plastics beer and cigars

Evansville is a farming trade center It also is a rail hub and suburban rail and highway bridges link it with cities south of the river Evansville lies on the border of the South and has taken on much of the South s pleasant charm Its business district adjoins the river and is fronted with a broad stone and concrete promenade atop the levee One of the city parks contains a zoo The city also has a museum of arts and history and Evansville College Near the city are a state hospital for the insane and Angel Mounds an ancient Indian burial ground

In 1812 Col Hugh McGary established a trading post here he also operated a ferry to the Kentucky shore In 1814 he laid out the town and named it for Gen Robert M Evans a later resident When Vanderburgh County was formed in 1818 Evansville was made the seat In 1853 the Wabash and Erie Canal linking Lake Erie and the Ohio River reached Evansville In the same year a rail line to Terre Haute began operations Although the city has suffered several damaging river floods its growth has been steadily It was incorporated as a town in 1819 and chartered a city in 1847 The city government is the mayor council form (*See also* Indiana) Population (1950 census) *128 636*

EVAPORATION A liquid exposed to the air gradually becomes a vapor or gas The change is called *evaporation* Common examples are clothes drying on a wash line and water vanishing from wet pavements after a rain Some liquids such as alcohol ammonia and gasoline evaporate more rapidly than water others such as glycerin and mercury more slowly Many solids also undergo a kind of evaporation called *sublimation*

To understand evaporation we must recall that the molecules of which every substance is made up are governed by two forces *cohesion* which tends to draw them together and the *heat motion* of the individual molecules which tends to make them fly apart (*see* Heat) When cohesion dominates the substance is a solid When heat motion is strong enough to overcome cohesion entirely the substance is a gas (*see* Gas) When the two forces are in fairly even balance we have a liquid

At the surface of a liquid molecules that happen to be moving outward more rapidly than their neighbors are likely to fly into space beyond the range of the force of cohesion This escape of molecules is evaporation It helps to explain many common facts

Effects of Temperature and Pressure

Warming hastens evaporation since the warmer the liquid the more molecules will have speed enough to escape The remaining liquid cools since the escape of the fastest molecules reduces the average speed of those left behind

In a closed container evaporation quickly stops because when the quantity of molecules in the vapor reaches a certain point the number that strike the

surface of the liquid and are recaptured equal the number escaping from the liquid. When this takes place, the vapor has reached its *saturation point*.

A vacuum hastens evaporation, since the fewer molecules there are above the surface, the smaller the chance that an escaping molecule will strike one of them and bounce back into the liquid. And, of course, the fewer will return by their own chance motion. Conversely, pressure which crowds together the molecules in the space above the liquid decreases evaporation. If the pressure is great enough it will force molecules back into the liquid, causing *condensation*.

At any given temperature, the pressure at which equal numbers of molecules are leaving and re-entering the liquid is called the *vapor pressure* or *vapor tension*. This varies for different liquids because the force of the cohesion of their molecules is different. Liquids of feeble cohesion evaporate rapidly and thus have high vapor pressures.

The evaporation of water is important in nature (*see* Water; Rainfall; Dew). It takes about five times as much water vapor to saturate the air at a temperature of 100° F. as it does at 50°. *Relative humidity* is the ratio between the actual amount of water vapor present in the air and the amount the air would contain at the existing temperature if it were saturated. A temperature of from 68° F. to 70°, with a relative humidity of from 50 to 60 per cent, is said to be ideal for health and comfort (*see* Heating and Ventilating).

EVEREST, MOUNT. The summit of Mount Everest in the Himalayas in Asia is the highest point on earth. For many decades expert mountain climbers scaled its glaciers and peaks in attempts to reach the top. Several men died in the effort. Finally in 1953 a British expedition succeeded. The team was led by Col. H. C. J. Hunt; the two men who actually reached the summit were E. P. Hillary of New Zealand and Tensing Norkay, a Nepalese-Indian guide.

The height of Mount Everest, long accepted as 29,002 feet, was fixed at 29,028 feet in 1954 by the Indian Survey. The loftiest mountain in Europe is less than two thirds as high. Seen from the Tibet side, Everest towers in solitary majesty. From the Indian side, it is almost hidden by other peaks. It was named for Sir George Everest, an English surveyor and geographer. (*See also* Himalayas.)

EVERGLADES. This vast tract of land and water formerly occupied an area of 5,000 to 8,000 square miles in southernmost Florida. It extended southward for about 100 miles from Lake Okeechobee and was 50 to 75 miles in width. A considerable part of it, however, has now been reclaimed by drainage. Settlers are growing bountiful crops of oranges, bananas, pineapples, and other fruits and vegetables on these lands. The southern part of the area became Everglades National Park in 1947 (*see* Florida).

EVERGREEN. A tree or plant which retains its foliage throughout the year, such as the pine, fir, hemlock, or laurel is known as an evergreen. Evergreens are in contrast with deciduous plants, which shed their leaves periodically and are leafless during part of the year. The term evergreen is often taken to mean any tree with cones and needles—in other words a conifer—as opposed to a broad-leaved tree; but not all conifers are evergreens. For example, tamarack and other larches are clothed with needles and cones but shed their foliage in the fall. On the other hand, certain broad-leaved tropical or semitropical trees such as the laurel are evergreen and do not lose their foliage in winter. (*See also* Trees.)

How EVOLUTION *Explains* VARIED *Forms of* LIFE

EVOLUTION. We all wonder about our ancestors—who they were, where they came from, and how they developed, back to the very beginnings of life. This article tells how scientists now answer these questions. It also explains why those answers are not final or complete.

Scientists realize that the *mental* and *spiritual* qualities of human beings set them apart from the rest of the living world. Man's "humanness" therefore is regarded as a special field, which cannot be considered here. On the other hand, the structures and functions of the human *body* are essentially like those of other creatures that possess backbones. These vertebrates, in turn, are linked with "lower" animals, with plants, and even with the members of two other living kingdoms (*see* Life).

What Evolution Means

Careful study has convinced most biologists that living things found on the earth today have developed, or *evolved*, from others of earlier times. Some of these modern forms are not very different from their ancestors. Modern horseshoe crabs, for example, still resemble those that lived ages ago. Through the ages other organisms have changed greatly. A good example is in the ancestral record of horses as shown by fossils (*see* Horse). Scientists have uncovered evidence suggesting that all modern horses descended from a little creature called *Eohippus* (the "dawn horse"), which lived more than 50 million years ago.

Another example is the series of fossils that leads from fish to amphibians, reptiles, and mammals. Other series show the opposite kind of change. They start from a well-developed creature and lead to others that have lost parts, and even the ability to take care of themselves. This is called *degeneration*. For example, many parasitic plants have lost the green material which enabled their ancestors to make food. They must attach themselves to some green plant and draw their food from it. Many parasitic animals have lost legs, eyes, and other parts possessed by their ancestors. They too must get their food from some other living animal.

This process of development, or change with descent, is called *evolution*. Biologists believe it has produced the enormous variety of living things in existence today, as well as many others that have died

out or become extinct. Biologists also believe that these processes of change are still going on. If they are they will produce many new forms of life in the centuries and ages to come.

Domesticated Plants and Animals Have Changed

Men gained their first knowledge about evolution from their own efforts to produce domesticated animals and plants. Wild cabbage, for example, is a plant with loose, green leaves that never form a head. From this wild ancestor farmers and plant breeders have developed head cabbage of several types, as well as kale, cauliflower, broccoli, Brussels sprouts and kohlrabi. Beets are descended from wild chard; sugar beets were developed after 1810 from a variety grown as feed for livestock. Modern tomatoes have come from a plant with fruit not much larger than cherries. It still grows wild in South America and northward into Mexico.

Members of the animal kingdom also have changed under domestication. The first poultry were jungle fowls. They were tamed during ancient times by people of Asia. From these ancestors have come bantams, Leghorns, Minorcas, Plymouth Rocks and the many other varieties of chickens now found throughout the world (see Poultry).

Still greater changes are shown by pigeons. Their ancestor is the wild rock dove. From these doves breeders have produced about 200 varieties, such as pouters, tumblers, fantails, barbs and carrier pigeons. Dogs have several wild ancestors, but breeders have produced many new varieties, from Pekingese to wolfhounds and great Danes (see Dogs).

Even fish have produced new varieties. The most familiar is the goldfish. Its ancestor was a small brownish species of carp first domesticated in China. Its descendants now range from pinkish white to golden orange, silver, and black in color. Some are stubby and others are thin, while several types have fins so large that they look like delicate veils.

Fossils Reveal Ancient Changes

Records of changes in domestic animals and plants go back only a few hundred or a few thousand years. Evidence of evolution during more ancient times must come from fossils. These are remains or traces of things that lived during early epochs and ages of earth history (see Fossils).

It is sometimes said that fossils trace the evolution of living things from the earliest and simplest forms to those that exist today. This is not quite true. The first organisms were too small and too soft to become fossils. So were most of those that followed them during the first billion years of life's history (see Geology). Yet during these early ages apparently all except one of the great animal groups, or phyla, appeared on the earth. Several groups of plants also appeared, as well as the simple things often called monerans and protists (see Life).

Many kinds of fossils have been found in rocks of the Cambrian Age and later times. Geologists estimate that early Cambrian fossils are about 500 million years old. From this beginning fossils offer a reasonably good record of never-ending change among the animal phyla and in the kingdom of plants. (See also Fossils; Prehistoric Life.)

Fossils That Show Ancestral Relations

Fossils also preserve many links between groups of animals and plants that followed each other in the long history of life. Certain fish, for example, possessed fins containing bones like those in the legs and feet of amphibians. From rocks of a later age come fossil amphibians whose skulls were fishlike. These specimens are accepted as evidence that animals with four legs, which could live on land, evolved from fish with leglike fins.

Other fossil links continue the series through reptiles to mammals, or beasts with warm blood and hair. Animals that lived in Texas some 230 million years ago had skeletons that are almost perfect links between those of amphibians and reptiles. Thirty or forty million years later a group of South African reptiles had changed so much that their skeletons were like those of mammals. True mammals appeared during the next geologic period.

Still other fossils link birds with small reptiles related to early dinosaurs. These fossils were birds, for they had feathers. But they possessed reptilian teeth and backbones that ran far down the tail, like the backbones of reptiles. A famous specimen is the Archeopteryx (for a picture, see Birds).

How Embryos Retrace Evolution

Many living animals pass through early stages that seem to repeat the evolution of their ancestors. The horse is a good example. Six weeks after an unborn colt begins to develop in its mother's body, it has three toes on each foot—a long toe in the middle and a shorter one at each side. The long toe grows larger and larger, but the short ones develop more slowly and then begin to dwindle. When the colt is born its side toes consist of four small bones hidden under the skin. These separate bones later join into two slender splints that lie close to the one remaining toe. With that change the colt finally becomes a modern one-toed horse.

The structure of insects suggests that their ancestors were wormlike creatures. An embryonic beetle or grasshopper actually does resemble a stubby worm with legs on its head and hinder part, or abdomen, as well as in the middle portion of its body. As the embryo develops, the legs on its head become mouth parts while those on the abdomen disappear. Only the middle or thoracic legs grow larger and remain legs in the fully developed insect.

Whales are warm-blooded animals (mammals) that live in water (see Whale). Their bodies are fishlike in shape and almost naked; they have no hind limbs but possess two sidewise fins, or flukes, on the tail. Young whale embryos, however, are covered with hair, develop hind limbs and have no flukes. As the embryos grow their hair disappears, the hind limbs dwindle to a few bones or vanish, and flukes grow out from the tail. In so-called whalebone whales the teeth also vanish before they grow through the gums. Biologists

accept these changes as evidence that whales evolved from four-legged animals with hair, ordinary tails, and teeth like those of other meat eaters.

The Evidence of Vestigial Organs

The tiny leg bones of whales are remnants, or *vestiges*, of organs that apparently became smaller and smaller as these animals evolved. Vestigial organs also give evidence of evolution in other creatures, from plants to birds and human beings.

Cactus plants have vestigial leaves which help to prove that these thick, juicy-stemmed plants had leafy ancestors. Vestigial legs in certain snakes provide evidence that serpents evolved from reptiles resembling lizards. Many cave-dwelling fish have remains of eyes, as if the creatures evolved from fish that lived in light and were able to see. The kiwi, a flightless bird of New Zealand, has tiny wings that are hidden by its feathers. Apparently it evolved from birds that had larger wings and were able to fly.

Man's vestigial organs include the appendix, muscles attached to the ear, and four "wisdom" teeth. All these are reduced remnants of structures that are useful in the bodies of lower animals that appeared on earth long before human beings. But the relation of man's body to the bodies of less advanced types is a complex problem that cannot be solved by study of vestigial organs alone.

Darwin's Views about Evolution

All these types of evidence were brought together by Charles Darwin in his book, 'The Origin of Species' (*see* Darwin). This book, published in 1859, proved to be the most powerful contribution ever made to the theory of evolution. In his book, Darwin argued for several great propositions, which together came to be called *Darwinism*. They are:

1. All living plants and animals seem to have evolved from earlier forms.

2. Evolution begins with variations that cause young living things to differ slightly from their parents and proceeds by accumulating variations from generation to generation.

3. Organisms with particular variations are *selected* and fixed as new living forms by the *survival of the fittest*. That is to say, there is constant struggle and competition in nature for food and other necessities of existence. Plants and animals which have helpful variations tend to succeed better than their rivals in this competition and live long enough to pass on these variations to their offspring. Variations which hamper a creature lead to failure in the struggle to exist, and such variations soon disappear.

These views provoked great controversy at the time; but gradually, scientists accepted evolution as a proved fact. But they questioned or modified many detailed aspects of Darwin's theory. For example, many scientists claim that while natural selection is a good general explanation of how evolution occurred, other factors must be added. One of them is called *isolation*. When living things spread over large areas, those that settle in different regions have different combinations of characteristics. Barriers keep them from mixing, and in time those of each special region become different from their relatives. Thus the chipmunks of eastern North America have divided into five groups that differ in color and in several other respects. Robins living east of the Rocky Mountains are darker than those of the Pacific coast, while song sparrows have separated into more than 20 species and varieties.

Another important means of producing new forms is *hybridization*—that is, crossing older, somewhat different forms to produce new ones. This process also occurs constantly in nature today as well as in past ages. Some of the new hybrids have become successful species that have crowded their parents out of their homes. Actually, however, the process of hybridization merely produces new combinations of forms that do not appear among the members of a single species. Survival depends upon natural selection, which favors the new, successful forms at the expense of others that are not so well equipped for survival.

An important gap in Darwin's theory was failure to explain why some variations are inherited, while others are not. Nonheritable variations, now called *modifications*, are caused by climate, food, illness, disease, activity, and other everyday conditions. Well-fed pigs, for example, grow to large size while those that are underfed or ill become stunted. Athletes develop powerful muscles though inactive persons do not. Trees on windswept slopes creep close to the ground, but those in sheltered valleys grow upright. Such modifications are not inherited.

Growing Understanding of Heredity

During the early years of the 20th century, the study of this problem was strongly influenced by two great contributions. One had actually been made in Darwin's time by an Augustinian monk, Gregor Mendel, but his work was ignored until about 1900. By his studies of inheritance in sweet peas Mendel proved that the inheritance of many characteristics is predictable according to mathematical formulas. This suggested that some physicochemical mechanism must be at work controlling heredity, presumably in the reproductive cells which give rise to new individuals.

The second contribution was the recognition of a kind of change called *mutation*. An outstanding leader in this field was the Dutch botanist, Hugo de Vries. A mutation is a variation which appears suddenly, from one generation to the next, and thereafter is inherited, unlike a modification.

The first mutations to be discovered were large, obvious ones; they produced new forms such as sheep with very short legs, gigantic evening primroses, and double sunflowers. These led some biologists to conclude that evolution had progressed by means of great jumps, called "saltations," and not by accumulation of small changes, such as Darwin envisaged. Later discoveries proved this to be a mistake. Large mutations are relatively rare, and some of those that have been described really have other causes. Small mutations, however, are common. They also take every possible form and are found in all sorts of creatures, from viruses and bacteria to man.

Biologists do not know why mutations occur. But the fact that they do occur and that such changes are

inherited sheds light on the processes of evolution It supports the view that a physicochemical mechanism in the germ cells controls heredity It also suggests that changes in this mechanism are the basis of evolution, they supply the variation in living things upon which natural selection works to cause evolution Modifications produced by environment or other influences consequently could not cause evolution if this view is correct Modifications may affect the body, but they do not reach deeply enough to alter the heredity mechanism and cause mutation (*see* Heredity) Hence they could not produce new species

DISTANCE *and* MYSTERY STILL LURE *the* EXPLORER

EXPLORATION. In the school geographies of the nineteenth century the maps showed many blank spaces marked "unexplored" These blank areas included nearly all of Africa and central Asia much of the interior of South America and Canada as well as parts of Australia, New Zealand New Guinea, Borneo, Sumatra, and other large islands

Africa was called the ' Dark Continent '—a land of unknown peoples, savage beasts, deadly fevers, and far reaching jungles South America was pictured as a white man s grave, a continent of dense forests swarming with wild beasts and head-hunting Indians Australia and New Zealand were sparsely inhabited, and seemed to be at the "very ends of the earth" Tibet was the forbidden land wherein no white man was permitted Alaska and nearly all of northern and central Canada were a trackless wilderness known only to Indians and a few fur trappers, traders, and Hudson's Bay Company representatives As for the Arctic and Antarctic regions most people jeered at the idea of anyone ever reaching the poles, even after Lieut A W Greely attained ' the farthest north ' of 83° 24' in 1882

TOWARD THE ICY SUMMIT OF MOUNT EVEREST

Many expeditions have set out to scale the summit of Mount Everest the world s highest point Here we see the expedition of 1924, commanded first by Brig Gen C G Bruce and later by Lieut Col E F Norton of the British army, crossing the icy Tibetan plains with their baggage carried by yaks

Today, however, one may drive an automobile or fly in an airplane the whole distance from Cape Town to Cairo, and men and women fearlessly set out on hunting trips to the heart of the African jungles Great steamships make regular trips up the Amazon, and tourists travel from Chile to Argentina by airplane or railway over the Andes Tibet, with its yaks, its monasteries, and its grotesquely garbed lamas, is brought to us in motion pictures and both the North and South poles have been not only discovered but mapped and photographed

Today we enjoy food that comes from places that were unexplored only a very few years ago We wear clothing made from the wool of sheep raised in Patagonia Tierra del Fuego or New Zealand. We drink coffee and cocoa grown in the heart of Africa and South America Our furs may have been trapped on Arctic islands the existence of which was undreamed of a few years ago When we stop at a roadside filling station we purchase gasoline made perhaps from oil brought from the wilds of South America Thus, exploration vitally affects our everyday life

This varied contribution of far-away places has come about because the past few decades have seen greater advances in scientific exploration than any similar period of time Adventurous men and some women have risked their lives and their health in wild savage, or desolate lands They have penetrated dense jungles, fought dangerous beasts met savages and cannibals, crossed great deserts, climbed lofty mountains, navigated uncharted seas and voyaged on unknown rivers They have endured these hardships sometimes amid blinding snow and ice or under equatorial sun in order to add to our knowledge of the lands and waters, resources and peoples of the earth

Exploring for Raw Materials

Just as the rapid exploration of America following its discovery was largely the result of the desire for gold and a richer commerce on the part of European nations so the achievements of present-day explorations have often been the result of the amazing advances made in science, commerce and industry The ever increasing use of automobiles, airplanes and other motor-driven machinery compelled the great oil companies to search for new sources of supply throughout the world As a result many of the most important recent geographical explorations were made by engineers and prospectors seeking oil They have explored and charted for the first time vast areas in Africa, Asia, Mexico, Central and South America, and

the East Indies. Other important explorations and surveys have been carried out by men in search of gold, silver, copper, tin, and other ores, and by representatives of business enterprises seeking to establish new avenues of trade.

The Department of Agriculture of the United States maintains a large force of experienced and daring men whose lives are devoted to exploring the most remote and least known portions of the world in a constant search for new plants, fruits, seeds, flowers, and vegetables to enrich our food supply and to add to our comfort. Hardier varieties of common plants are sought. Our supply of new and beautiful woods for interior furnishings and cabinetwork has been increased by men who have spent years in equatorial forests exploring hitherto unknown districts.

SAVING WATER FOR "THE GREAT THIRST"

Bushwomen of the Kalahari Desert region in Africa fill shells of ostrich eggs with water and hide them to provide for the dry period. These little-known people were visited by the Vernay-Long expedition in 1930.

Many expeditions are encouraged and supported by universities and by scientific organizations, such as the National Geographic Society, the Smithsonian Institution, the American Geographical Society, the Carnegie Institution, the Royal Geographical Society of Great Britain, and museums. Zoölogical gardens and other agencies constantly are sending out expeditions into every quarter of the earth, and while these men are studying the birds, beasts, reptiles, and insects of unknown districts, they are securing also geographical and commercial data.

The combined explorations of the ethnologists, the archeologists, and the fossil-hunters, or paleontologists, probably exceed those of all other explorers. To study primitive races, ethnologists must explore the most remote and unknown districts. In order to find the remains of ancient peoples, archeologists spend months, often years, hundreds of miles from civilization; and paleontologists explore deserts and mountains to collect the petrified skeletons of prehistoric monsters. As these men are scientists, trained to observe and to record every detail of their surroundings, they give us maps, photographs, sketches, and field notes, which help to fill in the ever-decreasing uncharted areas on our maps. (*See* Archeology.)

Occasionally an industrial development or an unexpected need has added to our geographical knowledge. When the sheep raisers of the Falkland Islands, the Argentine, and southern Chile required new pasturage for their rapidly-increasing flocks, Tierra del Fuego was thoroughly explored and mapped. If the first World War had not brought a tremendously increased demand for metals, rubber, and many other articles, parts of Africa, South America, Asia, and the East Indies might still remain virtually unknown. On the other hand, many of the world's richest mines were discovered by men in search of wild animals, primitive races, strange plants, ancient ruins, or geographical knowledge. Others who have brought back supposedly worthless curios, souvenirs, or specimens from faraway lands have added immeasurably to our store of drugs, medicines, and plants. Even art and design have been influenced by the discoveries of explorers.

The automobile, the motor boat, the airplane, the motion-picture camera, and the radio have greatly aided recent explorations. Airplanes have roared over both the North and the South poles. Col. Charles A. Lindbergh, Dr. J. Alden Mason, and others have located and mapped important ancient ruins of the Maya in Central America. In Peru, Bolivia, and elsewhere, the airplane has proved indispensable in surveying and mapping the Andes region, and in locating and photographing Inca and pre-Inca ruins. In New Guinea, seaplanes following the courses of the rivers helped explorers to accomplish more in a few weeks than could otherwise have been done in years. The frozen wastes of northern Canada and Alaska have been brought into direct connection with civilization by means of airplanes.

With the aid of motor boats, explorers have penetrated hitherto unexplored swamps and jungles bordering on tropical streams. Automobiles and motor trucks made possible the American Museum of Natural History expeditions into the Gobi Desert of Mongolia. With motor vehicles, capable of covering 100 miles a day, the work of ten years could be done in a single season. Although these expeditions, conducted by Roy Chapman Andrews with a staff of scientists, 40 porters, over 100 camels, and a fleet of automobiles and trucks, were primarily in search of fossils and traces of ancient man, yet other scientific data were also secured. To most persons, the dinosaur eggs obtained by these expeditions are regarded as their most remarkable discovery, but perhaps the most significant find was a prehistoric monster somewhat resembling a giant rhinoceros. This immense beast, the *Baluchitherium*, stood 13 feet high and was over 24 feet in length, and could feed upon the leaves of trees 22 feet above the ground.

Through the radio, explorers in the most remote regions have kept in touch with the outside world. Admiral Richard Byrd at the South Pole, the Hobbs expedition at Mount Evans in Greenland, the Rice expeditions on the upper Amazon, all talked nightly

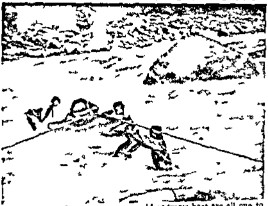
with friends at home. In their camps they heard radio broadcasts from stations in the United States.

After the second World War military expeditions were launched in the Far North. They located new air bases, tested equipment and developed oil fields to service the ships and planes that traveled the great circle routes in the polar regions. The Navy also experimented with carrier operations in Arctic waters. These expeditions were given such code names as "Exercise Musk Ox" and "Expedition Frostbite."

Exploring the Ocean

The depths of the sea have yielded many secrets to 20th-century explorers. John E. Williamson pioneered in undersea photography. William Beebe and Otis Barton developed diving devices called the bathysphere and the benthoscope which could withstand water pressures at 3,000 to 4,500 feet (*see* Beebe). In 1953 Auguste and Jacques Piccard dived over 10,300 feet in a bathyscaphe, but this record was broken in 1954 by two French naval officers who, using a similar device, descended over 2½ miles (*see* Ocean). The atomic submarine will probably enlarge the scope of undersea explorations (*see* Submarine). Other scientists and oceanographers have long been exploring the beds of the oceans. Professor Alexander Agassiz, Prof. Spencer F. Baird, Prof. A. E. Verrill, the Prince of Monaco and others devoted many years to this branch of exploration. As a result innumerable varieties of valuable sea foods have been discovered.

HARDSHIPS ARE THE EXPLORER'S LOT



Fast streams, dense jungles, icy cold or tropic heat are all one to the explorer in quest of the unknown. A balsa raft of the George Dyott expedition is here shown wrecked in an Andean river but sturdy natives and strong ropes salvaged the load

The tilefish or scrod, now one of our most important food fishes, was found through the explorations of the United States Fish Commission off the New England coast. Deep-sea scallops, now marketed in great quantities, were unknown until discovered by Professor Verrill while exploring the bed of the sea. The habits of lobsters, fishes, oysters and other marine creatures of great economic value were all learned by deep-sea studies. The explorations of deep-sea life made by the Prince of Monaco added immeasurably to our knowledge of ocean currents and the haunts and habits of whales. The surveys of the depths of the ocean made by the nonmagnetic ship the *Carnegie* were of great importance to mariners and scientists.

Perhaps the most interesting results of exploration are not the discoveries of new mountain ranges, rivers and cataracts but the finding of strange peoples, rare

THE FLYING LINDBERGHS OBSERVED THESE ANCIENT TEMPLES

The eastern part of Yucatán peninsula has regions of jungle and forest which present almost impassable barriers to land travel. In October 1929 Charles A. Lindbergh and his wife Anne explored these regions by air. During one of their flights this picture was made of Chichen Itzá, best known of all the magnificent stone cities of the ancient Mayan Indians (see Mayas)

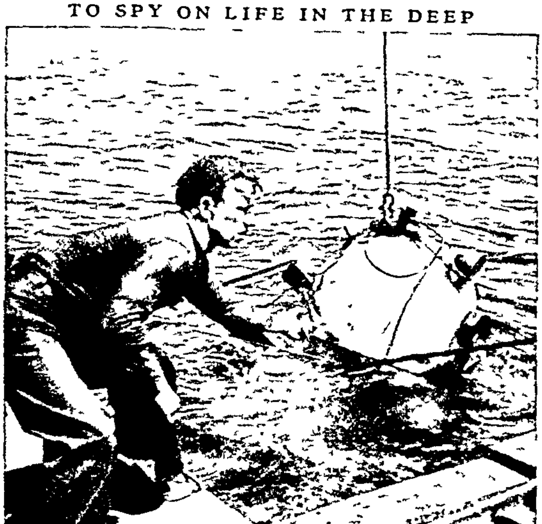
A GEIGER COUNTER

A geologist listens in on a machine that will tell him whether the rock he taps contains radioactive material.

animals, and remains of forms of life now extinct. Such discoveries as the Rhodesian skull in South Africa and the Peking skull in China have thrown new light on early man (*see* Man). Harry Johnston found the rare okapi in central Africa (*see* Giraffe). Pygmies, regarded as fabulous when reported about 1860 by Paul du Chaillu, have been found in the Belgian Congo and in New Guinea (*see* Pygmy). Bushmen living in a Stone Age culture were discovered in the Kalahari Desert in southern Africa.

The James Simpson-Theodore Roosevelt, Jr., expedition found the Ovis poli, or Marco Polo sheep, and the Asiatic ibex, a creature resembling a mountain goat. Giant lizards, or "dragons," were first discovered by an aviator on the island of Komodo in what is now Indonesia. The giant panda, last of a distinct family of mammals resembling bears, was obtained by the William C. Kelley-Roosevelt Asiatic expedition for the Chicago Natural History Museum. In the western part of the United States were found the remains of fossil bison, ground sloths, and other prehistoric beasts killed by Stone Age weapons. The bones of mastadons, associated with those of human beings, were found in Ecuador. Other South American discoveries were the gorgeously attired mummies of the ancient Parakans of Peru and the mummy of a royal Inca.

TO SPY ON LIFE IN THE DEEP



In this benthoscope, in 1949, Otis Barton dived 4,500 feet into the Pacific off California. Man's greatest descent into the sea was made in 1954 off Dakar, French West Africa. Two French officers, in a bathyscaphe, dived over 13,200 feet (about 2½ miles).

Polar expeditions are told of in the article on Polar Exploration. These have given us geographical and meteorological facts. Still more knowledge has been gained by the discovery of the remains of a great forgotten empire in Mongolia, made by Col. Peter Koslov in 1923; Charles W. Furlong's trip across Patagonia and Chile; the discovery of the Valley of Ten Thousand Smokes in Alaska; Prince William of Sweden's explorations in Uganda; and the British explorations of the Nile basin.

Important discoveries were made as a result of E. S. Grogan's journey afoot from Capetown to the Mediterranean in 1900; the explorations of Hassanein Bey and Mrs. Rosita Forbes through the African deserts in 1920; the Theodore Roosevelt River of Doubt expedition in 1913; the journeys of Miss Gertrude Bell, perhaps the first woman to truly deserve the title explorer, through unknown Arabia; and the explorations in Arabia of Maj. R. E. Cheesman in 1923–24, when he discovered the oasis of Jabrin in the Rub'al Khali (desert) and found ruins of ancient cities. Professor A. Hyatt Verrill in 1924 discovered the remains of a lost civilization in Panama, with its Temple of One Thousand Idols, its marvelous pottery and sculptures, all of which, like Pompeii, were covered centuries ago by a volcanic eruption.

Of great value was the exploration in 1917 of the great Arabian Desert by H. St. John B. Philby, the second white man to cross the arid waste from the Persian Gulf to the Red Sea. He mapped the desert and oases and followed the pilgrim route to Mecca.

Among the most adventurous and tragic expeditions were the 11 attempts to reach the "roof of the world"—the summit of Mount Everest, 29,028 feet above sea level. First attempted in 1921, the peak was not climbed until May 1953, when a New Zealander, E. P. Hillary, and a Nepalese, Tensing Norkay, together won the summit. This British expedition was led by Col. H. C. J. Hunt. After the climb both Hunt and Hillary were knighted by Queen Elizabeth II.

Few modern expeditions hope to be the first in some little known part of the world. Instead, explorers and scientists try to gain new knowledge of the past, of the ocean bottom, or of stars that are millions of light-years away.

One of the most interesting of recent expeditions was the 4,300-mile drift made in 1947 aboard a balsa raft by Thor Heyerdahl, a Norwegian ethnologist, and five companions. In 101 days their raft drifted

from Peru to the Tuamotu Archipelago thus proving possible Heyerdahl s theory that the Polynesians came from South America

A 1952 expedition found a canyon in the Atlantic Ocean that was comparable in size to the Mississippi River and its tributaries Another used aqualungs (oxygen supply tanks) to enable men to swim as deep as 300 feet below the ocean surface

This article has told only of the explorations of this century Other explorations are described in other articles (*See also* America, Middle Ages, Northmen, etc , and names of great explorers)

MODERN TITANS *with which Man* MOVES MOUNTAINS

ON Oct 10 1885 a group of men sat in a wooden cabin overlooking Hell Gate the narrow passage in the East River which connects Long Island Sound with New York harbor Half way across stretched Flood Rock, making a dangerous barrier to navigation. One of the men pressed an electric key The ground trembled, there was a rolling muffled roar The vast bulk of Flood Rock rose slightly, then fell and vanished Within a minute, 25 feet of churning muddy water was flowing over the spot where the rock had stood Imagine a solid mass of stone as big as a city block and 15 stories high blasted away in less than 60 seconds! What is the mighty power that did this work? Nothing but "chained wind"—the expansive power of gases suddenly set free, about which this article tells you.

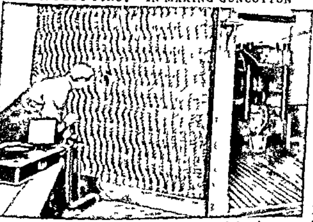
EXPLOSIVES The most powerful explosive force under man's control is atomic energy This force is explained in the article on Atoms. Other kinds of explosives are chemical substances which change suddenly into hot gases when struck or set afire The gases expand with terrific force and exert pressure on their surroundings When ordinary gunpowder, or black powder is fired in a closed space the expanding gas increases the pressure within the space 6 000 times "High explosives such as dynamite, TNT, guncotton, and nitroglycerin are far more powerful Mercury fulminate one of the most violent of the high explosives, can develop a pressure of 200 tons a square inch The strongest cannon barrel ever made would fly apart under such pressure

What causes the sudden release of gases which we call an explosion? To understand this we must first realize that many solids and liquids are composed in whole or in part of substances which ordinarily are gases Water, for instance, consists of the gases hydrogen and oxygen, mercury fulminate is composed of mercury, carbon, and the gases nitrogen and oxygen Water is not explosive, while mercury fulminate is This is because the hydrogen and oxygen which form the water are very "friendly" to each other—they are linked by a strong chemical attraction and cannot be easily separated, while mercury fulminate is an unstable compound and its components do not get along well together—they are constantly looking for an excuse to split up If struck or rubbed or pressed, they fly apart very suddenly

Instead of the solid mercury fulminate, therefore, we have two gases—nitrogen and carbon monoxide—and mercury vapor, which occupy vastly more space now they are separated than they did when combined It is the sudden and violent moving of the gases and vapors into this new space that constitutes the explosion These gases are like "unchained winds "

Any substance which breaks up easily and suddenly, producing a large volume of gas, is an explosive There are some, like nitrogen iodide, which are so sensitive they will explode at the tread of a fly or the touch of a feather There are others which require a hot flame to set them off

"SAFETY FIRST" IN MAKING GUNCOTTON



In the corner to the right is a press used in making the high explosive guncotton It must be tended like any other piece of machinery but since guncotton has a way of exploding out of turn every now and then the job of running the press is not a popular one The difficulty is solved in part by the rope screen with the peep hole Here the operator takes shelter with his controls and in case of accident has a chance for his life

Broadly speaking explosions may be of two kinds—extremely *rapid burning* as in the case of gunpowder, and *detonating* as in the case of mercury fulminate or nitroglycerin In the first case, the flame starts in one spot and spreads quickly over the entire mass In the case of detonation, however, a shock or jar causes all parts of the substance to "let go" at virtually the same time Guncotton illustrates both kinds of explosion If set off by a flame it will usually burn rapidly, creating a large quantity of gas, but without exhibiting extreme violence If, however, a cap or primer or

fuse made of some detonating substance like mercury fulminate be set off in contact with the guncotton, the latter will in turn be detonated. The ordinary dynamite stick can be set on fire with a match without great danger, but will explode with shattering force in response to a fulminate cap.

Since the first form of explosion is merely extremely rapid burning, it follows that any inflammable substance can become more or less explosive if it can be made to burn rapidly enough. Since all ordinary fire or combustion is caused by the combination of the burning substance with the gas oxygen (*see* Oxygen), it follows also that the more oxygen is present the faster will be the blaze. For example, coal gas, hydrogen, and the vapors of gasoline, alcohol, ether, turpentine, etc., are themselves non-explosive, but they become explosive if they are mixed in the right proportions with the oxygen of the air. The loud back-firing so frequent in a gas stove is caused when too large a supply of air is admitted to the gas pipe through the vent. This principle of explosive mixture of gases and vapors with air is used in all gas engines (*see* Internal Combustion Engine).

Many serious accidents have arisen from so-called "dust explosions." When the air is filled with finely powdered charcoal, coal, flour, soap, wood, sugar, starch, or any other combustible substance, a flame or a spark may start a blaze which will travel through the dust cloud so rapidly that it creates a violent and destructive blast.

Explosives which are to be used for practical purposes, however, cannot depend upon the air for their supply of oxygen. It must be provided in concentrated form so as to be available even when the explosive is excluded from contact with the air. In black gunpowder, which is a mixture of charcoal, saltpeter, and sulphur, the saltpeter (potassium nitrate) provides oxygen (*see* Gunpowder). But in most explosives, each molecule of the compound contains all the oxygen needed. Liquid oxygen itself can be used as an explosive. A porous cartridge of wood pulp, powdered aluminum, or other combustible material is soaked in liquid oxygen, and fired with a detonator before the oxygen evaporates. Instantaneous combustion produces terrific explosive force. A few detonating explosives, such as nitrogen iodide, have no oxygen; they act when the compound splits and the parts expand because of heat generated by the break.

Why Most Explosives Have Nitrogen

Some compound of nitrogen is used in most explosives because this element is extremely "unsocial" and ready to break away from the others in the compounds (*see* Nitrogen). It is usually introduced through the action of nitric acid, as a rule mixed with sulphuric acid. With cotton, nitric acid forms guncotton and nitrocellulose; with glycerin, it forms nitroglycerin; with ammonia, ammonium nitrate. With phenol (carbolic acid) it produces picric acid, the base of such explosives as lyddite and melinite. Nitration of toluene obtained from coal tar or by catalysis of gasoline yields trinitrotoluol or trinitrotoluene (TNT), one of the commonest military high explosives. Dynamite is nitroglycerin mixed with some absorbent substance to reduce danger of explosion from shock (*see* Dynamite and Nitroglycerin). Amatol is a mixture of TNT and ammonium nitrate; ammonal contains powdered aluminum, TNT, charcoal, and ammonium nitrate. The second World War saw the development of RDX (hexamine and TNT) and pentolite (pentaerythritol tetranitrate and TNT). Each one is more powerful than TNT.

Getting "Smooth" Explosives in Firearms

High explosives are used as bursting charges in shells and bombs, but they cannot be used as propelling charges to drive projectiles from guns, because they act too violently. Modern propelling charges are made from slower burning nitrocellulose, formed into grains, flakes, or cylinders. (Cordite and ballistite contain some nitroglycerin as well.)

When a propelling charge is fired, it burns slowly at first and starts the bullet or shell smoothly on its way. The rate of burning increases as the projectile nears the muzzle, and maximum pressure is provided at the instant of discharge. In this way the projectile is given an amount of driving force which would burst the gun if applied earlier.

This action can be obtained by coating the grains with a slow-burning compound. The compound retards emission of gas until it is gone. For bigger guns, the United States military services use a powder made into cylindrical grains. Inside each grain are lengthwise perforations. As the grain burns these perforations become larger and give off more gas.

Shells and bombs are exploded at the target by *detonators*. These are small charges of a sensitive explosive such as mercury fulminate. They explode at a blow from a firearm hammer. A detonator is also used as a *primer* to fire the propelling charge.

Peaceful Uses of Explosives

Explosives are of immense value in many peaceful pursuits—in mining, quarrying, and engineering enterprises, in making fireworks, signal lights, and rockets. They are used to project lifelines to ships in distress off storm-beaten shores or to the roofs of burning buildings; to cast oil upon rough seas or to break up ice-jams. When pile drivers are not available, their work can be done by exploding dynamite on an iron plate placed on top of the piles. Floating derelicts which endanger ships at sea are destroyed with explosives, and great fires are halted by blowing up buildings in their path. Farmers use them for breaking up bowlders, blowing out stumps, felling trees, and loosening the soil for deep cultivation.

Most nations and states, however, find it necessary to regulate carefully the sale of explosives, for in the hands of lawless persons they are powerful instruments of crime, such as blowing open safes and vaults by "cracksmen," or making bombs and "infernal machines" by political fanatics and others. (For the history of explosives *see* Gunpowder.)

EXPRESS—*Fast, Safe* DELIVERY *by* LAND, SEA, *and* AIR

Faster and still faster was the motto of the Pony Express riders The clothes and equipment shown in this photograph are authent c

EXPRESS If Mr Wells wants to run an express to the Rocky Mountains he can for all of me Personally I think it would be fool sh to try it

That statement was made in 1840 by William F Harnden He was trying to discourage one of his young employees Henry Wells who had suggested their express company extend its bus ness westward

Young Wells was not discouraged however In a few years he and William Fargo cofounders of the famous Wells Fargo express company were able to say 'The Rocky Mountains are only a way stat on on our line

Express messengers were known even in ancient times Perhaps the first ones were the Persian cour iers who carried mail to the king The runners who delivered fresh fish daily to Roman housewives were in a sense expressmen Early stagecoach drivers who carried packages for delivery along their routes were more like our modern expressmen

How Express Originated in America

Express as it is known today—a company in bus ness to carry goods valuables and money safely and qu ckly to their destinations—originated in America Some author t es say L B Earle and h s brother B D Earle were the originators The Earle brothers started carrying express messages under their beaver hats between Boston and New York in 1835 Others cred t Silas Tyler with its invention In 1835 Tyler ran an express car on a Massachusetts railroad between Boston and Lowell

W lliam F Harnden however who later discouraged Henry Wells from looking westward is generally cons dered to be the father of express He put an ad ert sement in the *Boston Transcript* on Feb 13 1839 offering h s serv ces as an express messenger to New York City once a week by boat and tra n Harnden had been a conductor on the Boston and Worcester railroad The railroad offic als refused to allow h m to be both an express messenger and their employee so he quit his job and put all his efforts into the express business

Henry Wells and W lliam Fargo began their partnership in 1844 Starting in 1845 their Western Express operated by stagecoach steamboat and wagon train from Buffalo to Chicago C nc nnati and St Louis Compet ng w th them was the Adams Express Company founded by Alvin Adams in 1840 with a route from New York City to St Louis by way of Baltimore Washington Pittsburgh Cin cinnati and Louisv lle

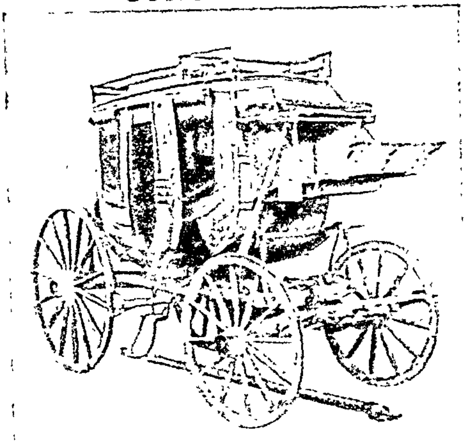
Also competing w th these compan es were the Butterfield and Wasson Express Company and the firm of Pomeroy and Company which Henry Wells had helped found when he first left Harnden s employ All these firms competed fiercely with one another and also with the Un ted States government for the mail-carrying business For many years express companies particularly Wells Fargo in the Far West had better reputations for the successful carrying of letters than d d the federal post office

In 1845 the postage rate for a letter between Buffalo and New York City was 25 cents Pomeroy and Company offered to carry letters for 6 cents Out of this controversy grew the uniform postal rate of 3 cents which the government adopted in 1848

Invention of C O D and Money Order

The American Express Company invented the C O D (cash on delivery) system This enabled

CONCORD COACHES CARRIED EXPRESS IN THE WEST



The Concord stagecoach, product of Yankee ingenuity and craftsmanship, helped in the winning of the West. At the left is pictured one of these stages now in Washington's Smithsonian Institution. Behind a six-horse team, the ruggedly built Concord stages rolled through the wilderness, carrying passengers, mail, and express. This is a stage on the California-Oregon run.

merchants shipping goods to have the express company collect the money from the customer. The government postal service then also adopted the C.O.D. system (*see* Post Office).

In 1864 the United States Post Office Department started a postal money-order form. This is a written form directing a post office to pay a specified sum of money to a certain person. The money order is bought and cashed at a post office. The American Express Company countered with a money-order form of its own, which for a time proved more popular than postal money orders because it could be bought and cashed almost anywhere.

In 1891 American Express produced its now-famous traveler's check, which is a form of a letter of credit (*see* Credit). A buyer writes his name at the top of a traveler's check or on the cover of a book containing the checks. To cash a check he again signs his name, this time at the bottom. The latter signature can then be compared with the original for identification. Travelers' checks are accepted over the whole world. They are now also issued by banks.

Founding the American Express Company

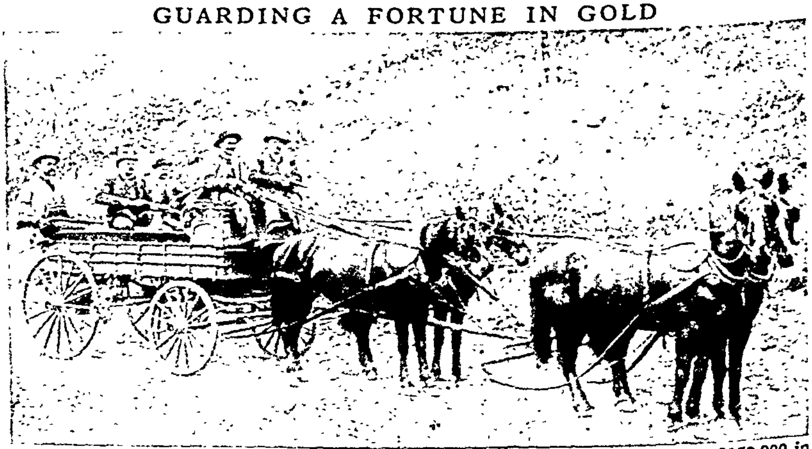
The American Express Company was formed on March 18, 1850. To get business, the rival express companies had cut the price of their service so much that they were all losing money. As a defensive measure, many agreed to sell their express lines to the newly formed American Express Company. Most owners of rival lines became directors in the new company.

Wells and Fargo were the leading figures in this new organization. In 1852 they suggested that American Express extend its operations to California. Here the Adams Express Company had all the business of transporting the millions of dollars' worth of gold that had been coming from California mines since 1849. The American Express directors would not approve of the venture. Wells and Fargo then formed Wells Fargo & Company, with offices in San Francisco and later in Sacramento.

Wells Fargo and Western Expansion

Wells Fargo played an important and dramatic part in the expansion of the American frontier. In 1859 an enormous silver deposit that has been called the greatest bonanza in the history of the world was discovered at Virginia City, Nev. Miners literally shoveled silver out of the ground in the form of "blue dirt" at the Comstock Lode. Wells Fargo, which had taken over the Pioneer Stage Line established in 1851 by Frank S. Stevens, had the monopoly

GUARDING A FORTUNE IN GOLD



This is an actual photograph of an early Wells Fargo "treasure wagon" carrying $350,000 in gold bullion from Deadwood, S. D. Express guards were called "the men who rode shotgun."

on carrying the silver from the Comstock and later banking the receipts in San Francisco at their offices on Montgomery Street In addition they had the monopoly on carrying goods and passengers to and from the Comstock Lode, from which business alone they made over a million dollars a year

Express in the West was carried in Concord coaches, which were built in New England They were handmade and cost $1,500 each So well were they built that many of the original coaches are still used in making Western motion pictures in Hollywood The Concords were drawn by three spans of horses which cost $3 000 a span A harness for the six horses cost $1 500 To defend their valuable cargoes guards called "the men who rode shotgun carried either shotguns or the repeating Henry rifle which could be 'loaded on Sunday and fired all week'

Founding the Overland Mail

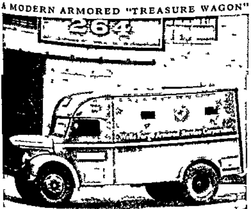
The Southern Overland Mail, in which Wells Fargo came to own a controlling interest was founded on Sept 15, 1858, by John Butterfield one of the American Express Company directors The Overland Mail stagecoaches ran from St Louis to San Francisco in 24 days through desert, mountains and bands of hostile Indians Freight on the Southern Overland was limited, the greatest load including mail was no more than 750 pounds Establishing the Overland Mail however, meant that mail and express no longer had to go by sea to Panama, across the Isthmus by land and then by sea again to San Francisco Wells Fargo shipped express via the Overland right up to the time of the Civil War

Coming of the Pony Express

There were minor Pony Expresses before 1860, but the Pony Express that rode its way into American legend was started by Russell Majors and Waddell, a firm of Kansas freight masters on April 3, 1860 It was officially discontinued on Oct 26, 1861, although it operated until November 20

Russell Majors and Waddell proposed to have its Pony Express riders travel over a central route

A MODERN ARMORED "TREASURE WAGON"



Today Wells Fargo operates a money delivery service in New York City The Concord coaches are gone but the armored trucks are still painted a traditional Wells Fargo red

the 2,000 miles between St Joseph Mo, and Sacramento Calif, in ten days on a regular schedule If they could do so they would beat the time it took Butterfield s Southern Overland to cross the continent The government would also award them valuable mail contracts

The string of streaking saddle horses was more than successful from a time standpoint but the Pony Express was a financial failure losing its owners over $200 000 in the 18 months of its existence Nevertheless it played a major role in establishing rapid communication between the loyal North and the West coast during the Civil War The Pony Express helped to keep California in the Union

The completion of the transcontinental telegraph ended the Pony Express and with the arrival of the Civil War the Southern Overland Express was moved to the Central Express route where it continued to operate until a railroad spanned the continent (*See* Telegraph Railroads Transportation)

The American "Camel Express"

A curiosity during the mid-19th century was the arrival on the Western scene of what has been called the "American Camel Express About 1850 Bactrian camels were imported to haul salt between several California and Nevada towns On Feb 1 1856 33 dromedary camels were landed at Indianola Tex Later 41 more camels were added to this group

The camels had been imported by the United States Army as an experiment in freighting and communication in the arid Southwest On an expedition to open a wagon road across Arizona from Fort Defiance to California the camels were said to have proved their worth The Army later abandoned its experiment however and the camels were left to shift for themselves on the desert They were a source of constant complaint by stagecoach drivers whose teams upon seeing the alien beasts would frequently bolt in panic The camels were seen haunting the Western desert as late as 1912

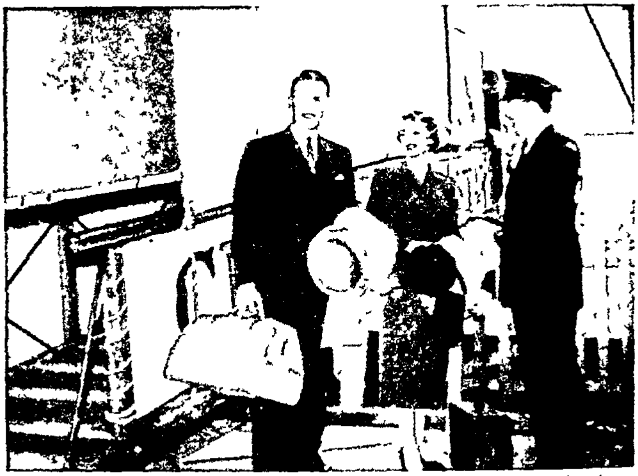
Express during the Civil War

During the Civil War express companies performed notable services They were hired by the federal government to deliver goods to its supply depots In the national election of 1864 an express company was given the responsibility of taking the vote of the soldiers at the front Another wartime welfare effort was performed shortly before and during the first World War When the first World War began the American Express Company succeeded in getting 150 000 panicky American travelers out of Europe American Express also undertook the first delivery of parcels to prisoners of war before the American Red Cross took over this job

After the Civil War rivalry once again became keen among the express companies The competition which grew in intensity for more than half a century, was based on efforts to secure exclusive express delivery contracts with the railroads Without these contracts the express companies could not deliver their goods The United States Express for

PACKAGES AND PASSENGERS VIA AIR AND SEA

The code word for today's air express is AIRYX. It is a division of the Railway Express Agency and is the only agency which is authorized to accept official "Air Express" shipments.



Here an American Express Company interpreter meets two travelers as their ship arrives in Europe. This express company's main business today is planning travel tours at home and abroad.

example, had an exclusive contract with the Erie Railroad; Adams and Southern had a contract with the Pennsylvania Railroad; and American Express had its contract with the New York Central. Other leading express companies in competition at this time included the National Bankers, Merchants Union, and Wells Fargo.

Wells Fargo did not regard the railroads as a serious threat to its business. This was a serious error. In 1872 the Pacific Union Express Company, which was an agency of the Central Pacific Railroad, announced it had a monopoly of passengers, merchandise, and express over their railroad and its connections. Since Wells Fargo was dependent upon the Central Pacific, they were forced into a complete reorganization of their company with the Central Pacific owners gaining control. This was something of a forerunner of what happened to all the express companies early in the 20th century.

Express Companies Merge

In 1910 the Mann-Elkins Act declared that the express companies were *common carriers* subject to the regulations and rate making of the Interstate Commerce Commission. On Jan. 1, 1913, the United States government started its parcel-post service. These two events cut seriously into the profits of the rival express companies.

On Dec. 28, 1917, William Gibbs McAdoo, secretary of the treasury, announced that the government was taking over the railroads to co-ordinate them with the war effort. All contracts between the railroads and the express companies were canceled. McAdoo also urged for the sake of efficiency that all the express companies consolidate into a single large company. At this time the four leading express companies in operation included Southern, Adams, Wells Fargo, and American Express.

These companies merged to form the American Railway Express Company, Inc., on July 1, 1918. Three of the companies—Adams, American Express, and Wells Fargo—maintained their names after the merger. Adams became an investment trust. American Express—not to be confused with the American Railway Express to which its previous express services now belonged—concentrated on the expansion of its travel department. This is its main business today.

Wells Fargo eventually became a part of American Express. Today it handles much of the American tourist trade in Mexico, and its banking department still operates as the Wells Fargo Bank and Union Trust Company in San Francisco. As a subsidiary of American Express in New York City, Wells Fargo also operates a money delivery service.

On March 1, 1929, the Railway Express Agency succeeded the American Railway Express. The Railway Express Agency today is owned by the railroads. It operates on 5,500 trains a day and on more than 315,000 miles of rail, steamship, truck, and air lines, carrying 100 million shipments a year.

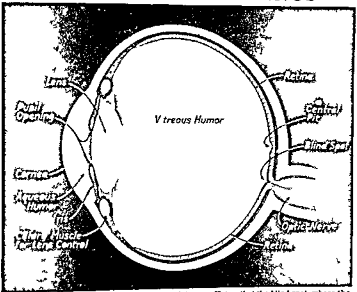
The Coming of Air Express

Express took wings for the first time on Nov. 7, 1910, when a merchant at Dayton, Ohio, shipped a bolt of silk by air to Columbus. The 60 miles was covered in 56 minutes, and the cost of expressing the bolt of silk was $71.42 a pound.

Air express progress was slow at first. Less than 4,000 pounds of air express packages were carried in 1926. By 1950 more than 75 million pounds were expressed by air. Today it is a common method used for the fast delivery of goods. Special items such as orchids from Hawaii and live lobsters from Maine are frequently delivered fresh to any point in the United States via air express. Air express makes it possible for newspapers to be printed in one city and sold the same day in other cities hundreds of miles away. All domestic United States airlines, Pan American World Airways, and Trans-Canada Airlines are authorized carriers of air express. (*See* Aviation.)

WHAT HAPPENS *When We* "SEE" THINGS

EYE When we look at an object the light reflected from it passes through the lens of the eye and an image is formed on the retina The action is the same as when a camera lens projects an image on photographic film In the eye however the image does not stop at the retina Like a television picture, it is transmitted through the optic nerve to the brain where it is recorded and where we recognize the object the image represents Let us look closer at the remarkable machinery that makes all this possible



In this diagram you are looking *down* into the right eye Notice that the blind spot where the optic nerve leaves the eyeball is off center toward the ns de of the head The co nea s the transparent part of the tough and fibrous covering which complete y su ounds the eyeball. The rest of the covering is the sc e a or white of the eye

Cornea and Iris

The first thing the light encounters on reaching the eye is the transparent *cornea* This is like a watch crystal on the front of the eyeball It begins at the edge of the white and covers the dark part In front it is protected by a thin mucous coating the *conjunctiva* The space just behind it is filled with a clear liqu d called the *aqueous humor* The cornea and the liqu d taken together form an outer lens of meniscus or crescent shape which gathers light rays over a wide angle and bends or *refracts* them toward the center of the eye At the back of the space that contains the aqueous humor lies the *iris*, a muscular tissue with a round hole in the middle of it This opening is the *pupil* which expands or contracts to control the amount of light that passes into the interior of the eye When we speak of the color of a person s eyes, we mean the color of the iris.

The Self Adjusting Lens

Through the pupil the light passes into the main lens This is biconvex like an ordinary magnifying glass But unlike a glass lens it is elastic and can change its focus

The change is controlled by an ingenious mechanism All around the edge of the lens is attached a membrane that contains scores of threadlike fibers Like the spokes of a bicycle wheel these fibers radiate from the lens to a muscle which is shaped like a tire This is called the muscle of accommodation or the *ciliary muscle*

When this muscle is at rest it is widest open and thus it keeps a constant slight tension on the fibers attached to the lens which tends to flatten the lens s surfaces In this condition the lens of a normal eye brings to a sharp focus on the retina the images of objects that lie 20 feet or more away

To bring nearer objects into focus the ciliary muscle contracts and the circle it forms becomes smaller Thus the pull on the edge of the lens decreases Through its own elasticity the lens draws together and its sides curve out more This of course shortens its focal length (*see* Lens) and the images of the nearer objects become sharp and clear on the retina When the ciliary muscle releases all tension on the lens the normal eye of a child can bring into focus objects as close as 2½ inches With age the elasticity of the lens decreases and a 50-year-old eye that can focus sharply on an object ten inches away is considered normal

The space between the lens and the retina is filled with a clear jelly like substance called the *vitreous humor* The rays of light that form the image pass through this with little or no change

The Retina and Its Tiny Detectors

The real act of seeing begins at the retina It is a transparent membrane and the image formed by the lens penetrates to its innermost structure There it encounters a layer made up of about a million tiny nerve cells These are of two kinds *rods* and *cones* so called because of their shapes They may be called the detectors of the eye and they divide up their work

The cones are very keen They detect the lines the points and the colors of the image The sharp details of the printing you see on this page for example are detected by the cones When you look up from the page and gaze through the window it is the cones that detect the green in the leaves of a tree and the blue of the sky There are special cones for each of the primary colors of light—blue-violet green and red and they cooperate in detecting the intermediate colors (*see* Color) It is the cones that make it pos-

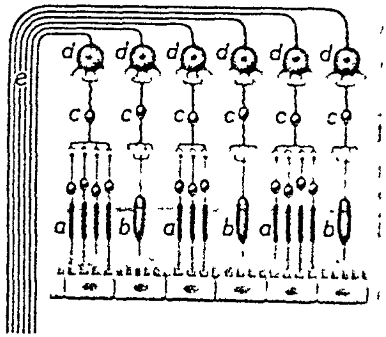
sible for us to do work that requires skill, discrimination, and accurate measurements.

Less acute than the cones are the rods. These detect no clear lines or points, and none of the colors, but only the tones—the lights and darks—of the image. In this they are exceedingly sensitive. They can distinguish the outlines or silhouettes of objects in almost total darkness where the cones can detect nothing at all. When we walk down a strange unlit street or through a dark unfamiliar room, it is the rods that enable us to find our way and avoid collisions.

The rods can detect an image in the dark because they contain a special pigment called *visual purple*. In bright light this substance turns yellow, and the rods lose their extreme sensitiveness, so we can stand the glare of the sun. But in the dark, the visual purple starts to form again, until the sensitiveness of the eye to light is multiplied about 2,000 times.

This explains what we mean by "getting used to the dark" when we walk into a motion-picture theater. It may take as long as 45 minutes for the visual purple to reach its maximum.

HOW THE RETINA WORKS



The image (made up of light rays) strikes down from the top, passing other elements in the retina, until it reaches the deeply buried rods (*a*) and cones (*b*). Here the light waves are transformed into electrical impulses which pass upward through bulbs, fibers, and across gaps to the bipolar cells (*c*). These in turn convey the impulses to the ganglion cells (*d*), which transmit them directly to the fibers of the optic nerve (*e*). Notice that there is a separate fiber for each rod and cone circuit.

The inability of some eyes to form sufficient visual purple results in so-called *night-blindness*. This is usually caused by a lack of vitamin A in the diet (*see* Vitamins).

The Geography of the Retina

Let us see how the rods and cones are arranged around the retina. The very center of the retina, a small depression called the central pit (*fovea centralis*) contains only cones. It is the area of most acute detection. This area is often called the "daylight eye" because it functions only in bright light. Around the central pit lies an area in which rods and cones are intermingled. Finally, around the outer part of the retina is an area that contains only rods. This is often called the "night eye." It is this area that enables us so readily to detect shapes and movements far on each side of the straight line of vision or, as we say, "out of the corner of the eye." In darkness, indeed, we may become aware of a faint shape off to one side or of a small dim light like a star, only to have it disappear from our vision when we turn to look at it directly. There is enough light to impress the rods, but not enough for the cones. Scientists say that this explains why some people think they see ghosts at night.

The Optic Nerve and the Blind Spot

When we say that the rods and cones "detect" the image thrown upon the retina by the lens, we mean that they transform the light energy that strikes them (with its varying wave lengths and intensities) into corresponding electrical or nerve impulses. These impulses then travel to the brain through the *optic nerve*.

This nerve is made up of hundreds of thousands of fibers—one for each cone in the retina and one for each small group or cluster of rods. The fact that the nerve impulses from several rods are fed into a single nerve fiber explains why their "messages" are stronger but less distinct than those of the cones.

At the point where the optic nerve leaves the eye, there are no rods or cones and, therefore, no light detection. This is called the "blind spot." To prove its existence for yourself, make two black spots about the size of a pea and about 3½ inches apart on a sheet of white paper. Now cover the left eye and keep the *right eye* sharply fixed on the *left-hand spot*. At arm's length you will clearly notice from the side of your eye the presence of the right-hand spot. But as you draw the paper nearer your face, you will find a place where the *right-hand spot seems to disappear*. This takes place when the image of that spot reaches the blind area of the retina. For success in this experiment the left eye *must* be kept covered and the right eye *must* be kept on the left-hand spot.

Where Vision Takes Place

The part of the brain to which the optic nerve delivers its impulses is called the *visual center* (*see* Brain). This is where we really "see" things in the sense of recognizing and understanding what our eyes look at. In other words, it is at this place that *vision* is completed—where sensation turns into perception. (*See also* Sensation and Perception.)

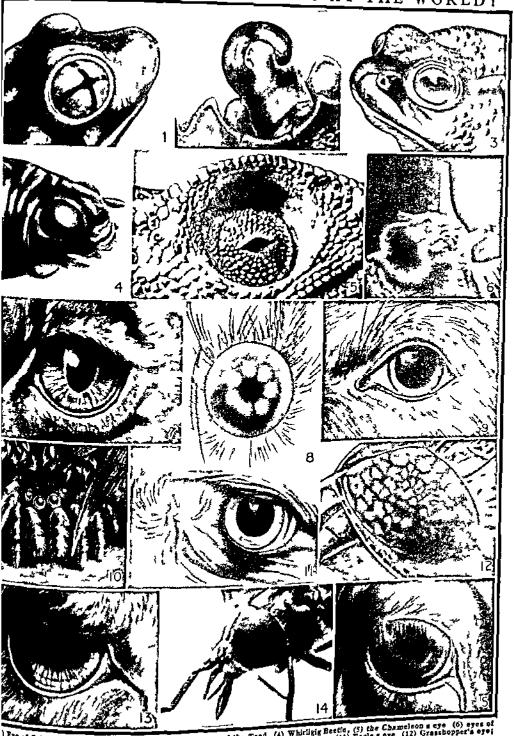
The brain must learn by experience to analyze correctly the messages it receives from the eyes. For instance, the lens system of the eye, like that of a camera, projects images that are upside down (*see* Lens). The brain has to learn that the impulses received from the *upper* part of the retina represent the *lower* part of the object sighted and vice versa.

In the brain also are located the centers that control all the eye's muscular movements, such as the opening and closing of the iris, the focusing of the main lens, and the movement of the eyeball. The movement of the eyeball is under voluntary control. The other adjustments of the eye are automatic reflexes (*see* Reflexes).

How the Two Eyes Work Together

Normally we use both eyes when we look at an object (*binocular vision*). Thus two images of the object are formed at the same time—one on the retina of each eye. Both images, of course, are sent to the brain, which has learned by experience to interpret them not as the images of two different objects, but as two views of the same object. Because the eyes are about 2½ inches apart from pupil to pupil, and there-

SEVERAL WAYS OF LOOKING AT THE WORLD!



) Eye of Solitary Frog, (2) stalk eye of Crab (3) eye of the Toad (4) Whirligig Beetle, (5) the Chameleon s eye (6) eyes of Snail on sta ks (7) Cat s eye (8) Moth s eye (9) eye of the Dog (10) Sp der eyes (11) Eagle s eye (12) Grasshopper's eye; (13 Sheep s eye (14) eye of the Fly (15) the Cow s eye Nos 4, 8 12 and 14 are compound eyes.

fore are looking at the object from different angles, the two views are not exactly alike (*stereoscopic effect*). If the object is far away, the difference between the images is slight, but becomes very great for an object that is only a few inches from the eyes.

The brain makes good use of this fact. It learns to judge the distance of an object by the degree of difference between the images it receives from the two eyes. In the same way the brain perceives what is called *perspective*, that is, the differences in distance between two different objects or between two parts of the same object (*see* Perspective; Sensation and Perception; Stereoscope).

(There are other ways of judging distance for which two eyes are not required. If we know the actual size of an object, we learn to estimate its distance from the size of the image it makes on the retina. When we do not know the size of an object, we can estimate its distance by scanning the intervening objects. For example, we can estimate how far a yacht is from the shore by scanning the waves between the shore and the yacht.)

The eyes are turned up, down, and sideways by long muscles attached at one end to the top, bottom, and sides of the eyeball and, at the other end, to the bony walls of the eye socket. These muscles are regulated with the most delicate precision so that normally they turn both eyes toward the same object at exactly the same time.

Persistence of Vision

While the eyes are in motion we cannot see an object clearly. The image on the retina must come to rest, if only for a tiny fraction of a second. That is why, when we scan a broad landscape, our eyes move across it in a series of quick jerks, with brief stops between them. The same thing happens when we read a line of type (*see* Reading).

On the other hand, when the image has registered, the vision of it persists from 1/25 to 1/50 of a second. That is why our eyes are deceived, so to speak, by motion pictures. A movie consists of a rapid series of still pictures flashed on the screen, with about 1/60 of a second of complete darkness after each one. But persistence of vision fills in the dark moment. It also blends each picture so perfectly with the one that went before that we get the same impression that true motion produces.

How the Eyeball Is Protected

The eyeball is well protected. It lies within a bony socket of the skull, embedded in fat. The eyelids guard it in front. They blink an average of once every six seconds. This washes the eyes with the salty secretion from the tear glands (*lachrymal glands*), keeping them moist and free from dust. Each tear gland is about the size and shape of an almond, situated behind the upper eyelid at the outer corner of the eye. After passing over the eyeball, the liquid from the gland is drained into the nose through the *tear duct* at the inner corner of the eye. When we laugh heartily or cry, muscles in the upper eyelid squeeze the lachrymal gland, and tears come out faster than they can be drained away.

The eyelashes catch many flying particles that otherwise would enter the eye. As a further protection, the eyelids automatically close when any object moves suddenly close to the eye.

Defects of Vision

Some eyes are abnormally long from front to back, and the lens, even when stretched to its flattest, cannot bring *distant* objects to a focus on the retina. Nearsightedness or *myopia* is the result. This defect is corrected by wearing a concave (negative) spectacle lens, which, together with the convex (positive) eye lens, makes an optical system of longer focus.

When the distance between the front and the back of the eye is too short, the lens, even when relaxed to the utmost, cannot bring *near* objects to a focus. This is a form of farsightedness called *hypermetropia*. Another and more common form is *presbyopia* (old eye), common in older people, in which the lens loses some of its elasticity and no longer swells out to its roundest when the muscles of accommodation relax the tension upon it. Farsightedness is corrected by a convex (positive) spectacle lens, which combines with the eye lens to produce a shorter focus.

In many eyes the cornea is deformed so its surface is oval instead of truly spherical. As a result, the light rays are distorted at their very entrance into the eye (*astigmatism*). Depending upon the direction of the cornea's oval curvature, it tends to blur the horizontal, the perpendicular, or the oblique lines of the image projected upon the retina. To correct astigmatism, spectacle lenses must be given a nonspherical (cylindrical) curvature offsetting the abnormal curvature of the cornea, so the two together will act as a spherical surface. (*See also* Spectacles.)

When the two eyes fail to work together in harmony because of muscular defects (as with cross-eyes or wall-eyes) or because of extreme differences in their focusing power, the images formed on the two retinas may be so unlike that they cannot be blended in the brain. Thus a double image is perceived (*double vision*). Unless this defect is corrected by prismatic spectacle lenses or by other methods, the brain learns to disregard entirely the image formed by one of the eyes, and fixes its attention on the other. In time the neglected eye may lose some of its visual powers.

Which Is Your Favorite Eye?

In general, even in persons with normal two-eyed vision, the brain gives greater emphasis to the image formed by one of the eyes. The favored eye may be called the "sighting eye." It can be identified by sighting a distant object across the end of a pencil, held at arm's length, keeping both eyes open. Now, when the "sighting eye" is closed, the distant object will be seen to shift out of line with the pencil.

Color Blindness

Imperfections in the cones of the retina, due to inheritance and more rarely to disease, cause defective color vision, known as *color blindness* or *Daltonism*, from John Dalton, a famous chemist who described his own case. In total color blindness, which is very rare, everything appears in different shades of gray as in an ordinary photograph. In its most common form, color blindness is the inability to distinguish between reds and greens. Both appear to be a grayish yellow. Though true color blindness is seldom cured, minor defects of color vision are sometimes improved by concentrated doses of vitamin A (*see* Vitamins).

Hygiene of the Eye

Eye injuries and pains or any inflammation of the eyelids should receive a doctor's attention. Fingers, dirty clothes, and caustic liquids should be kept away from the eye. Many eyes are saved in factories by the rule that goggles must be worn by all who are exposed to intense heat and light, flying particles, or spraying liquids (*see* First Aid; Health).

Surgery sometimes restores sight by replacing cloudy corneas with clear ones from eyes willed to hospitals by dying persons. These may be stored briefly in the hospital "eye bank" until they are needed.

THE EASY REFERENCE FACT-INDEX

GUIDE TO ALL VOLUMES FOR SUBJECTS BEGINNING WITH

D-E

TO SAVE TIME

USE THIS INDEX ☞

EDITOR'S NOTE ON NEXT PAGE TELLS WHY

SPECIAL LISTS AND TABLES

Numerous other lists and tables in the fields of geography, history, literature, science, mathematics, and other departments of knowledge will be found with their appropriate articles in the main text

EDITOR'S NOTE

EVERY user of Compton's Pictured Encyclopedia should form the habit of *first* turning to the Fact-Index section at the end of each volume when in search of specific information. This index is a miniature work of reference in itself and will often give you directly the facts, dates, or definitions you seek. Even when you want full treatment of a subject, you will usually save time by finding in the index the exact page numbers for the desired material.

All page numbers are preceded by a letter of the alphabet, as A-23. The letter indicates the volume. If two or three page numbers are given for the topic you are seeking, the first indicates the more general and important treatment; the second and third point to additional information on other pages. Where necessary, subheadings follow the entry and tell you by guide words or phrases where the various aspects of the subject are treated.

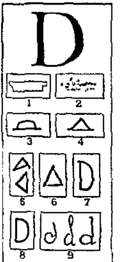
The arrangement of subheadings is alphabetical, except in major historical entries. In these the chronological order is followed.

The pictures illustrating a specific subject are indicated by the word *picture* or *color picture* followed by a volume indicator and a page number. A picture reference is frequently intended to call attention to details in the text under the illustration as well as to the illustration itself. This picture-text, therefore, should always be carefully read. The pictures are usually on the same page as the text to which you are also referred; sometimes they are found in a different but related article which will add interest and information.

The pronunciations given are those preferred by the best and most recent authorities; alternative pronunciations are indicated where usage is divided.

In recent years hundreds of foreign geographical names have been changed, either officially or by custom. Both old and new names are given at the appropriate places in the alphabet.

Populations are those of the latest census or an official estimate when available if no census has been taken since World War II. Distances between points are map or air distances, not distances by railroad.



Our letter D probably started in Egyptian writing as a picture of a door (1). To the Egyptians this picture meant door. Shortly after 2000 B C a Semitic people called the Semites adopted it as an alphabetic sign for the sound of d, because their word *daleth* for door began with this sound.

The surviving Semitic inscriptions have been so badly weathered that the sign is almost illegible (2) but the door appears clearly in the later Canaanite Phoenician alphabet. Many of the city dwellers made the sign look like a house door but slightly rounded (3); others imitated the wedge shaped or cuneiform letters of Mesopotamia and used a triangle in the sign (4). The triangle prevailed in later Canaanite writing (5). The name of the sign remained *daleth*.

When the Greeks learned how to write from the Phoenicians they took over the triangular sign but they straightened it up (6) and named it *delta*. An Italian colony of Greeks from Chalcis curved the letter slightly (7) somewhat as the city dwelling Semites had, and this shape led to the Latin form (8). From Latin the capital letter came without change into English.

In handwriting the triangle became a rounded form (9) which was easier to make. This form appears in manuscripts of the 1st century after Christ. Both our printed and handwritten small d have high vertical strokes at the right.

Note.—For the story of how alphabetic writing began and developed *see* the articles Alphabet; Writing.

IMPORTANT DAMS IN THE WORLD

Name	Location	Purpose*	Year Completed	Height in Feet	Length in Feet	Material in Dam (Cubic Yards)	Reservoir Capacity (Billions of Gallons)
Álvaro Obregón	Mexico	I	1953	187	4,370	11,143,300	792
American Falls	Idaho	I	1927	94	5,227	313,600	554
Anderson Ranch	Idaho	FC-I-P	1950	456	1,350	9,653,300	161
Aswan	Egypt	I-FC	1902, 1912, 1933	175	6,983	1,732,000	1,303
Bartlett	Arizona	I-FC	1939	287	1,063	182,300	58
Bhakra	India	P-I	UC	680	1,600	5,120,000	1,140
Bonneville	Oregon-Washington	P-N	1937	170	1,250	617,000	241
Bull Shoals	Arkansas	FC-P	1952	278	2,349	2,100,000	1,762
Burrinjuck	Australia	P-I	1927	247	765	408 000	252
Camarasa	Spain	P	1920	333	400	283,000	29
Chambon	France	P-FC	1935	430	1,080	392 000	4
Chelsea	Quebec, Canada	P	1927	100	1,765	170,000	645
Cherry Creek	Colorado	FC-I	1950	140	14 300	14,650,000	60
Chief Joseph	Washington	FC-N-P	UC	235	2,315	4,100,000	156
Clark Hill	Georgia-South Carolina	FC-P	1952	200	5,660	4,350,000	945
Davis	Arizona-Nevada	P-RR-I	1949	200	1,300	4,357,500	593
Denison	Oklahoma-Texas	FC-P-RR	1943	165	14,000	17,913,000	1,898
Detroit	Oregon	FC-N-P	1953	440	1,580	1,670,000	145
Diablo	Washington	P	1930	386	1,180	350,000	29
Dnieper	Russia	P-N	1932	200	2,500	900,000	293
El Azucar	Mexico	I-FC	1943	142	18,000	5,625,000	555
Elephant Butte	New Mexico	I-P	1916	301	1,674	629,400	753
El Palmito (Lázaro Cardenas)	Mexico	I-P	1948	302	787	7,000,000	1,063
Falcon	Texas-Mexico	I-FC-P	1953	150	26,294	12,576,000	1,331
Folsom	California	FC-I-P	UC	340	10,230	14,100,000	326
Fontana	North Carolina	FC-P	1944	480	2,385	2,812,000	521
Fort Peck	Montana	FC-P-N	1940	250	21,026	128 000,000	6,327
Fort Randall	South Dakota	FC-I-N	UC	160	10,000	28,000,000	2,248
Friant	California	I-FC	1944	319	3,488	2,134,700	170
Garrison	North Dakota	FC-I-N	UC	210	12,000	75,000,000	7,495
Gatun	Panama Canal Zone	N-FC	1912	115	7,700	25,107,000	1,436
Génissiat	France	P-FC	1948	340	650	8,750,000	17
Granby	Colorado	I-RR	1949	295	885	2,901,300	178
Grand Coulee	Washington	I-P-RR-FC	1942	550	4,173	10,585,000	3,101
Grand Dixence	Switzerland	P	UC	912	2,297	8,100,000	105
Green Mountain	Colorado	I-P	1943	309	1,300	4,372 000	50
Grimsel	Switzerland	P	1931	377	810	445,000	26
Hansen	California	FC	1940	122	10,509	14,700,000	19
Hirakud	India	P-FC-I-N	UC	180	15,722	16,400,000	1,955
Hoover (formerly Boulder)	Arizona-Nevada	FC-RR-I-P	1936	726	1,244	4,400,000	10,148
Hume	Australia	I-P	1936	142	5,300	4,425,900	652
Hungry Horse	Montana	I-FC-P	1952	564	2,115	2,950,000	1,140
Kenney	British Columbia, Canada	P	1953	325	1,500	3,700,000	7
Kentucky	Kentucky	FC-N-P	1944	206	8,422	8,518,700	1,956
Kerr, or Polson (Flathead Lake)	Montana	P-I	1938	200	350	77,000	397
Kingsley (Lake McConaughy)	Nebraska	I-P-FC	1941	162	10,700	26,000,000	768
La Angostura	Mexico	I-P	1941	291	515	190,237	335
McNary	Oregon-Washington	I-FC-P-N	1953	187	7,400	1,850,000	286
Marshall Ford (Lake Travis)	Texas	I-P-FC-RR	1942	278	5,128	3,389,000	621
Mauvoisin	Switzerland	P	UC	745	1,720	2,600,000	41
Mettur	India	I-P	1934	230	5,000	2,000,000	699
Mud Mountain (Stevens)	Washington	FC	1948	425	700	2,230,000	42
Norris	Tennessee	FC-P	1936	265	1,860	1,184,000	836
Oahe	South Dakota	FC	UC	230	9,300	78,000,000	7,104
O'Shaughnessy	California	WS-P	1923, 1938	430	840	675,000	114
Owen Falls	Uganda	I-P	1954	100	2,500	52,000	...
Owyhee	Oregon	I	1932	417	833	537,200	365
Parker	Arizona-California	WS-P	1938	320	856	380,000	234
Pine Flat	California	FC-I-P	1953	440	1,845	2,240,000	362
President Alemán	Mexico	I-P	UC	200	10,000	...	1,629
Roosevelt	Arizona	I-P-FC	1911	280	1,125	355,800	456
Ross	Washington	P	1949	545	1,275	965,000	456
St. Mary	Alberta, Canada	I	UC	191	2,536	4,500,000	2,204
Salt Springs	California	P	1931	328	1,260	3,171,500	42
Saluda	South Carolina	P	1930	208	7,838	11,160,800	689
San Gabriel No. 1	California	FC	1938	381	1,540	10,641,000	14
Cogswell (San Gabriel No. 2)	California	FC	1935	290	620	1,200,000	3,465
Santa Giustina	Italy	P	1951	492	295	156,840	45
Sardis	Mississippi	FC	1940	117	15,300	16,868,000	512
Sautet	France	P	1934	414	263	130,400	35
Shasta	California	I-P-FC	1945	602	3,460	6,541,000	1,464
Shingmun	China	WS	1937	285	695	641,000	...
Shipshaw No. 1	Quebec, Canada	P	1931	200	3,030	357,000	37
Tignes	France	P-FC	1952	590	980	825,000	62
Watauga	Tennessee	FC-P	1949	320	900	3,534,500	221
Wilson (Muscle Shoals)	Alabama	P-N	1925	137	4,862	1,259,400	183
Wolf Creek	Kentucky	FC-P	1954	240	5,736	10,250,000	1,984

*FC—Flood control P—Power I—Irrigation N—Navigation RR—River regulation UC—Under construction WS—Water supply

Francis Dana born Cambridge Mass wrote Two Years before the Mast classic sea story describing voyage as seaman to California later distinguished as jurist and international lawyer Autobiographical Sketch (1815–1842) pub lished 1953 A 327

Danae (*dăn ā-ē*) in Greek mythology mother of Perseus P 154

Danaides (*dă nā ĭ-dēz*) in Greek mythology the 50 daughters of Danaüs, king of Libya doomed to fill sieves with water throughout eternity for killing their husbands at their father s command

Danbury, Conn., famous hatmaking city 60 mi n e of New York City pop 22 067 Danbury State Teachers College settled 1684 C 438 *map* C 444

Dance D 14–14m A 400a–b 400 *pictures* D 14–14m
American Colonies A 194 D 14k *picture* A 193d
ancient D 14c–d *pictures* D 14c, d E 284
ballet B 28–28d *pictures* B 28–28d
ballroom or social dancing D 14m
books about H 400–1
etiquette at social dances E 408
folk dance F 192a–d, *pictures* F 192a–d
form D 14a
Guatemala, *picture* G 222b
Hawaiian Islands hula dance H 288b *picture* H 289, in old Hawaii H 289
Indians, North American *See in Index* Indians North American subhead dance
Middle Ages D 14e
modern dance D 14 14j–k *pictures* D 14–14a, j in musical shows D 14m
Muse of M 454
Oriental D 14f–g *pictures* D 14f
primitive D 14b–c, C 434b *pictures* D 14b C 434d *color picture* A 38
Russia R 275 *picture* R 273
Scotland *picture* S 63a
stage dancing D 14c, k–m *See also in Index* Ballet
technique D 14a
Tibet, *picture* T 128
toe dancing D 14h

Dance Thumbkin Dance game P 319

Dance of death D 14e

Dancy a mandarin orange O 400

Dandelion flowering herb of composite family D 14n, *color picture* F 179
pollen grain *picture* P 186

Dandie Dinmont terrier *table* D 118b

Dandruff in hair H 243

Dane Clemence pen name of Winifred Ashton English novelist and dramatist first novel Regiment of Women published 1917 (other novels First the Blade Legend The Babyons, dramas A Bill of Divorcement inspired by English divorce law and Will Shakespeare in blank verse)

Danegeld (*dān gĕld*) a tax levied in England 10th to 12th centuries this tax originated as a tribute to the Danes

Danelaw, or **Danelagh** territory in England ceded to Danes by Alfred the Great E 359

Danes a Teutonic people living in Denmark S 55, D 66 70
invasion of England E 359, A-152 C 117

Daniel Hebrew prophet central figure of the Book of Daniel P 418–19

Daniel Anthony (1601–48) Canadian Jesuit missionary born Dieppe France went to Canada with Samuel de Champlain 1633 worked among the Hurons and established Indian school for boys murdered by the Iroquois

Daniel Samuel (1562–1619) English poet and historian (sonnet series to Delia Complaynt of Rosamond prose history of England) his verse praised for grace and tender feeling

Daniel Deronda George Eliot s last novel story of a young Jew reared a Christian unaware of his Jewish ancestry who returns to his own people E 330

Daniell John Frederick (1790–1845) English physicist inventor of a gravity electric (Daniell) cell still in use of a pyrometer and other scientific instruments

Daniell cell for generating electric current B 80

Daniels Jonathan Worth (born 1902) author son of Josephus Daniels born Raleigh N C editor of the *Raleigh News and Observer* administrative assistant to President Roosevelt 1943–45 in A Southerner Discovers the South he speaks frankly of economic and social conditions The Man of Independence is a biography of Harry S Truman

Daniels Josephus (1862–1948) journalist and political leader born Washington N C editor *Raleigh (N C) News and Observer* after 1894 secretary of navy 1913 21 ambassador to Mexico 1933–41 (Our Navy at War Wilson Era Shirt sleeve Diplomat) *picture* R 203

Danilova (*da nē lō va*) **Alexandra,** American ballerina born Peterhov Russia educated Imperial Ballet School Petrograd (now Leningrad) member Russian State Ballet 1922–24 later with Diaghilev Ballet, Col de Basil s Ballet Russe Ballet Russe de Monte Carlo in U S after 1934 *picture* B 28c

Danio any of several species of tropical fish belonging to family *Cyprinidae* *color picture* F 104–5

Danish language and literature S 65 *See also in Index* Scandinavian languages Scandinavian literature
Hans Christian Andersen A 242 4

Dannay Frederic *See in Index* Queen Ellery

Dannecker Johann Heinrich von (1758–1841) German sculptor friend of Schiller his work a constant struggle between classic and naturalistic schools S 79

D Annunzio Gabriele *See in Index* Annunzio

Danse macabre D 14e

Dante Alighieri (*dăn tā ä lē gyā rē*) (1265–1321) greatest Italian poet D 14 i–15 *pictures* D 14n I 259
Divine Comedy story of D 14 15
influence on Italian language I 259
Longfellow s translation L-310
portraits by Giotto D 14n G 111

Dantès (*dän tĕs*) Edmond hero of Alexandre Dumas s Count of Monte Cristo sailor who condemned through conspiracy to life imprisonment escapes gains buried treasure and returns to dazzle Paris as the fabulously wealthy count of Monte Cristo and to mete out special punishments to his foes

Danton (*dän tōn*) **Georges Jacques** (1759–94) French revolutionary leader D 15 R 163
inaugurates the Reign of Terror F 294
leads Jacobins J 290

Danube (*dăn ūb*) River ancient Ister 2d river of Europe extends 1750 mi from the Black Forest in s w Germany to the Black Sea D 15 16 E 421 H 448 *maps* E 417 419 B 23 P 156 *pictures* B 24 H 449
Austria A 493
basin *map* D 18
Rumania R 253

Danvers Mass historic town 4 mi n w of Salem of which it was once a part pop of township 15 720 birthplace of Israel Putnam home of John Greenleaf Whittier shoes leather crayons lamps and chemicals state insane asylum *map inset* M 132
Peabody endowment P 101
witchcraft persecutions W 180

Danville Ill trade center for farming dairying and coal mining region 115 mi s of Chicago pop 37 864 hardware paper boxes brick rail road shops National Soldiers Home home of Joseph G Cannon long time Republican leader *maps* I 38 L 253

Danville Ky stock raising center 40 mi s of Frankfort pop 8686 various manufactures Centre College Kentucky School for the Deaf *map* K 31

Danville Va city near s boundary on Dan River and 58 mi s e of Roanoke pop (1950 census) 35 066 (after 1951 annexation 44 658) tobacco market textile products tobacco processing 2 junior colleges for women *maps* V 486 U 253

Danzig (*dăn tsĭk*) Polish Gdansk Poland Baltic seaport on the Vistula River pop 191 051 D 17 W 247 *maps* G 88 P 344 E 424

Daphne (*dăf nē*) a nymph in Greek mythology D 17
grove at Antioch A 265

Daphne a genus of plants chiefly shrubs of the mezereum family native to Eurasia Some are evergreen with uncut leaves fragrant white lilac or greenish tubular flowers in clusters Juice of some used in medicine

Daphnia or **water flea** a minute crustacean D 17

Daphnis and Chloe (*klō ē*) Greek pastoral romance by Longus Daphnis a boy and Chloe a girl found by shepherds grow up together come to love each other and in the end are happily married

Dapsang Mount India *See in Index* Godwin Austen

D Arblay Frances *See in Index* Burney Fanny

Darby Pa borough on Darby River 4 mi s w of Philadelphia pop 13 154 textile mills one of oldest boroughs in state settled 1660 *map inset* P 133

Darby and Joan (*jōn*) John Darby (died 1730) and his wife Joan original of hero and heroine of Henry Woodfall s ballad Darby and Joan or The Happy Old Couple illustrating wedded bliss

Dardanelles (*där da nĕlz*) (ancient **Hellespont**) narrow strait separating Europe from Asia D 17–18 *maps* B 23 T 225 I 417 *pictures* D 17 *See also in Index* Hellespont
Istanbul I 258
World War I W 223

Dare Virginia (born 1587) first child born of English parents in America N 278

Dare small fish *See in Index* Dace

Dar el Beida French Morocco *See in Index* Casablanca

Dar es Salaam (*där ĕs sä läm*) sea port on Indian Ocean capital of Tanganyika Territory e Africa pop 69 227 *maps* E 199 A 47

Darfur (*där fûr*) westernmost division of former Anglo Egyptian Sudan 138 150 sq mi pop 949 640 cereals tobacco cotton fruits cattle cap El Fasher

David (*dä'vid*), **House of**, communal religious colony in Benton Harbor, Mich.; founded 1903 by Benjamin Franklin Purnell (King Ben) (1861–1927), not associated with any other sect; in 1930 community split into House of David and Israelite City of David; members wear beards and do not smoke, drink, or eat meat.
David, Star of. *See in Index* Star of David
David, Tower of, in Jerusalem, *picture* J-336
'David Balfour', by Robert Louis Stevenson sequel to 'Kidnapped'.
'David Copperfield', novel by Charles Dickens D-84, 85, N-311
Uriah Heep, *picture* D-84b
'David Harum', novel by Edward Noyes Westcott (1847–98), hero a shrewd horse trader and humorous homely philosopher
Davidson, Jo (1883–1952), sculptor, born New York City, known for his portraits of famous people—Pershing, Clemenceau, Will Rogers, F. D. Roosevelt, John D. Rockefeller, George Bernard Shaw
Davidson, John (1857–1909), English poet, deeply pessimistic, best known for ballads; wrote 'Bruce', 'Scaramouch in Naxos' fantastic plays, 'Fleet Street Eclogues', 'Earl Lavender', romantic story.
Davidson, Randall Thomas, first baron of Lambeth (1848–1930), English divine; bishop of Rochester 1891–95; bishop of Winchester 1895–1903, archbishop of Canterbury 1903–28
Davidson College, at Davidson N. C.; for men; Presbyterian; founded 1837; arts and sciences
Davies, Arthur B. (1862–1928), artist of great versatility, born Utica, N. Y., best known as a painter; a sensitive dreamer and a mystic; for a time work showed influence of cubism; designed tapestries for Gobelin industry in France ('Maya, Mirror of Illusions'; 'Afterthoughts of Earth').
Davies, Sir John (1569–1626), English poet and statesman, born England; attorney general for Ireland 1606–19; speaker Irish Parliament 1613–19 (poems: 'Orchestra' and 'Nosce Teipsum').
Davies, Sir Louis Henry (1845–1924), Canadian statesman and jurist; premier Prince Edward Island 1876–82; Liberal in House of Commons 1882–1901, when he became judge of Supreme Court; minister of marine and fisheries 1896–1901.
Davies, Mary Carolyn, writer, born Sprague, Wash.; best known for musical, wistful, sentimental verses ('Drums in Our Street', 'Youth Riding', 'Penny Show').
Davies, William Henry (1871–1940), British poet of Welsh parentage; was tramp and peddler in America and England for several years; published first book of verse at 34 ('The Soul's Destroyer'); 'The Autobiography of a Super-tramp' is account of early wanderings; in his 'Collected Poems' are lyrics of great simplicity and charm.
Dávila (*dä'vē-lä*), **Pedrarias,** also **Pedro Arias de Ávila** (1440?–1530), Spanish governor in Central America; governed Darien and adjacent lands 1514–26; extended tyrannical rule by founding Panama 1519 and other colonies; executed Balboa for insubordination; transferred to Nicaragua 1526
daughter marries De Soto D-73b
names Panama P-52
Da Vinci, Leonardo. *See in Index* Vinci, Leonardo da
Davis, Arthur Hoey (1868–1935), pseudonym Steele Rudd, Australian humorist, born Drayton, near Toowoomba, Queensland (stories of rural life, 'On Our Selection').
Davis, Bette (born 1908), actress, born Lowell, Mass.; christened Ruth Elizabeth; after short, successful career on stage, entered motion pictures 1931; twice won Academy award for acting, for work in 'Dangerous' (1935) and in 'Jezebel' (1938); also starred in 'Of Human Bondage', 'Now, Voyager', and 'All about Eve'
Davis, David (1815–86), jurist, born Cecil County Md.; justice U. S. Supreme Court 1862–77; U. S. senator 1877–83.
Davis, Dwight F. (1879–1945), statesman, born St. Louis, Mo.; lieutenant colonel in World War I; secretary of war 1925–29, governor general of Philippines 1929–32, established Davis Cup as international trophy for tennis 1900
Davis, Elmer (Holmes) (born 1890), writer, journalist, and news analyst (radio and television), born Aurora, Ind.; on staff *The New York Times* 1914–24, director Office of War Information 1942–45 (essays: 'But We Were Born Free'; novels and short stories).
Davis, George (1820–96), lawyer and statesman, born New Hanover County, N. C.; attorney general Confederate States of America 1864–65.
Davis, Henry Winter (1817–65), statesman, born Maryland; as Whig member of Congress from Maryland (1855–61, 1863–65) opposed Lincoln's policies and urged stringent reconstruction program.
Davis, James John (1873–1947), public official, born Wales; came to U. S. in 1881; worked in steel mills; secretary of labor under Harding, Coolidge, Hoover; U. S. senator from Pennsylvania 1930–45; director general Loyal Order of Moose after 1906, founder of Mooseheart Home and School.
Davis, Jefferson (1808–89), president of the Confederate States of America D-22–3, *picture* D-22
Confederate States of America C-433–433b, D-22–3
Greeley signs bond G-212–13
oath as president, in Montgomery M-380
Robert E. Lee and L-156
Statuary Hall. *See in Index* Statuary Hall (Mississippi), *table*
"white house" home, *picture* A-120
wife D-23, *picture* D-22
Davis, or Davys, John (1550?–1605), English navigator, Arctic explorer; discovered (1587) Davis Strait: A-190
cross-staff, *picture* N-79
Davis, John William (1873–1955), lawyer and diplomat, born Clarksburg, W. Va.; member of Congress 1911–13; solicitor general U. S. 1913–18; ambassador to Great Britain 1918–21; Democratic nominee for presidency 1924.
Davis, Marguerite, biochemist V-497
Davis, Mary Gould (born 1882), writer of children's stories, born Bangor, Me.; supervisor of storytelling, New York Public Library 1922–44; editor of Books for Young People, a department of the *Saturday Review* ('A Baker's Dozen', 'The Truce of the Wolf', 'Girl's Book of Verse')
quoted S-405
Spanish tales S-416
Davis, Norman H. (1878–1944), statesman, born Bedford County, Tenn.; financial adviser to government during and after World War I; assistant secretary of treasury, 1919–20; undersecretary of state, 1920–21; member League of Nations Financial Commission; became national chairman of American Red Cross 1938.
Davis, Owen (born 1874), playwright, born Portland, Me.; nearly 200 plays ('Nellie, the Beautiful Cloak Model'; 'Icebound', Pulitzer prize play 1923; 'The Nervous Wreck').
Davis, Rebecca Harding (1831–1910), author, born Washington, Pa.; American pioneer in realistic fiction ('Life in the Iron Mills').
Davis, Richard Harding (1864–1916), novelist and journalist; born Philadelphia, Pa., son of Rebecca Harding Davis; war correspondent in Spanish-American, South African, Russo-Japanese wars and World War I, wrote breezy, stirring stories, full of adventure ('Soldiers of Fortune'; 'Van Bibber and Others'; 'The Bar Sinister').
Davis, Sam (1842–63), Confederate hero, born near Smyrna, Tenn.; hanged at Pulaski, Tenn., when captured inside Federal lines with military information. Asked to betray source of information, he answered: "If I had a thousand lives to live I would lose them all before I would betray my friends or the confidence of my informer." His home, near Smyrna, 20 mi. s.e. of Nashville, is a state shrine; statue on Capitol grounds, Nashville.
Davis, Stuart (born 1894), painter, lithographer, and writer on art, born Philadelphia, Pa.; works show influence of modern art
'Summer Landscape' P-23a, *color picture* P-23b
Davis, Varina Howell (1826–1906), wife of Jefferson Davis D-23, *picture* D-22
Davis, William Hammatt (born 1879), lawyer and arbitrator, born Bangor, Me.; administrator and national compliance director, NRA 1933–34; chairman, National Defense Mediation Board 1941–42; chairman National War Labor Board 1942–45; director, Office of Economic Stabilization, March–October 1945.
Davis, William Morris (1850–1934), geographer and geologist, born Philadelphia, Pa.; on faculty Harvard University 1876–1912, became professor of geology ('The Coral Reef Problem'): G-47
Davis, Mount, in Pennsylvania. *See in Index* Negro Mountains
Davis and Elkins College, Elkins, W. Va.; Presbyterian institution opened in 1904; arts and sciences
Davis Cup, awarded annually to nation winning amateur men's tennis team championship. Cup donated 1900 by Dwight F. Davis, American statesman.
Davis Dam, in Arizona and Nevada, on the Colorado River C-415, *maps* A-352, N-133, C-414b, *picture* N-131. *See also in Index* Dam, *table*
Davisson, Clinton J. (born 1881), physicist, born Bloomington, Ill.; member of technical staff of Bell Telephone Laboratories; Nobel prize 1937 (with George Paget Thomson of London) for experimental discovery of the diffraction of electrons by crystals: P-235
Davis Strait, between Greenland and Baffin Island; width 180 to 500 mi.; discovered by John Davis: *maps* N-250, 245, C-69
Davits. *See in Index* Nautical terms, *table*

(Academy award winner for best film of 1952) · *picture* M-414

De Mille, James (1837–80), Canadian novelist and teacher, professor at Dalhousie University 1865 to 1880 ('Helena's Household', 'A Strange Manuscript Found in a Copper Cylinder', 'The Dodge Club').

Deming, N. M. city 80 mi n.w. of El Paso; pop. 5672, minerals and large fields of yucca in vicinity, health resort *map* N-179

Democ'racy, government by the people, in its pure form exercised by them directly; in a representative democracy or republic, through their chosen representatives. D-63–7
- American Colonies A-216, R-123, U-370–1: town meeting, *picture* U-370
- ancient Greece G-198, D-63: from Sophists' ideas G-145; Solon's laws S-233
- Bill of Rights B-145
- birth of, in ancient Greece W-209–10
- compared with Fascism F-44
- dangers and drawbacks D-66–7
- dictators replace in Europe D-65–6
- England rise in D-64–5, M-41, P-87
- France F-293, F-269: Rousseau's influence R-236
- free cities of Middle Ages D-64
- German Republic (1919–34) G-98
- individual freedom I-115–20, *Reference-Outline* I-117–20
- Latin America D-65
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- Roman struggle for freedom D-63–4
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- United States D-65, U-374–5, C-331

Democrat'ic party (U. S.) P-358, 359, A-16. *See also in Index* Republican party (Jeffersonian); Tariff; names of presidents
- Civil War and following C-337, U-381
- electoral vote, *chart* P-408*b*–9
- free silver U-383, M-18, B-334
- Hayes-Tilden controversy H-296–7
- Jackson's influence J-286
- Jefferson's principles J-331
- presidents elected. *See in Index* President of the U. S., *table*
- slavery issue divides D-125
- symbol, *picture* P-357
- Tammany Society T-9
- tariff policy T-18–19

Democratic-Republican party (*Jeffersonian*) P-358, J-332*b*–*c*, H-253

Democritus (*dē-mŏk'rĭ-tŭs*) (5th century B.C.), Greek philosopher; called "Aristotle of 5th century," also ineptly styled the "Laughing Philosopher," as Heraclitus was the "Weeping Philosopher"
- atomic theory A-457

Demogorgon (*dēm-ō-gôr'gŏn*) (Greek, "horrible demon"), mysterious fabled being, by some medieval and ancient writers identified with ruler of the underworld.

De Molay, Order of, a nonsectarian secret organization of young men between the ages of 16 and 21, founded in 1919 at Kansas City, Mo., and named in honor of the martyred Jacques de Molay, last grand master of the Knights Templars. The Order is governed by a Grand Council of Freemasons, and the chapters are sponsored by Masonic bodies: F-283

Demonstrative pronoun P-417

De Morgan, William (1839–1917), novelist, born London, England; for 30 years an artist-potter; known for his brilliant blue and green glazes; began to write at 65, for amusement after illness; excels in naturalness of dialogue, his characters often more important than plot; best novels 'Joseph Vance', 'Alice-for-Short', 'Somehow Good'

RULERS OF DENMARK SINCE THE UNION OF KALMAR

DENMARK, SWEDEN, AND NORWAY

1397–1412	Margaret and Eric VII (Eric XIII of Sweden)
1412–1438	Eric VII (alone)
[1438–1440	Interregnum]
1440–1448	Christopher III
1448–1481	Christian I
1481–1513	John
1513–1523	Christian II (Sweden revolts and becomes independent 1523)

DENMARK AND NORWAY

1523–1533	Frederick I
1533–1559	Christian III
1559–1588	Frederick II
1588–1648	Christian IV
1648–1670	Frederick III
1670–1699	Christian V
1699–1730	Frederick IV
1730–1746	Christian VI
1746–1766	Frederick V
1766–1784	Christian VII
1808–1839	Frederick VI (regent 1784–1808) (Norway annexed to Sweden, 1814)

DENMARK

1839–1848	Christian VIII
1848–1863	Frederick VII
1863–1906	Christian IX
1906–1912	Frederick VIII
1912–1947	Christian X
1947–	Frederick IX

Demosthenes (*dē-mŏs'thē-nēz*) (about 383–322 B.C.), most famous Greek orator D-67, *picture* D-67
- place in Greek literature G-211

Demot'ic writing (Egyptian) D-285

Dempsey, William H. (Jack Dempsey) (born 1895), boxer, born Manassa, Colo
- heavyweight champion B-271, *picture* B-271, *table* B-272

Dempster, Arthur Jeffrey (1886–1950), American physicist, born Toronto, Canada, to U. S. 1914, became citizen 1918, at University of Chicago after 1919
- discovers isotope of uranium A-462*b*

Demuth (*dē-moth*), **Charles** (1883–1935), painter, born Lancaster, Pa.; expert draftsman; noted for paintings of fruits, flowers, buildings; precise line, luminous color, emphasis on planes; cubistic technique in later work.

Demy (*dē-mī'*), size of paper B-239

Denain (*dē-năn'*), coal-mining and iron-manufacturing town in n. France, 6 mi. s.w. of Valenciennes; pop. 22,299; victory of French over allies under Prince Eugène 1712.

Dena'li, or Tralelka, also **Bulshala**, native names for Mt. McKinley.

Dena'rius, a Roman coin of silver, later one of copper, the "penny" of the New Testament; "denarius" was Latin name given to English penny; hence its initial (d.) became sign for pence.

Denatured alcohol A-145

Denby, Edwin (1870–1929), lawyer and Cabinet official, born Evansville, Ind.; secretary of navy under Harding and Coolidge 1921–24, resigned as result of Teapot Dome scandal; in World War I enlisted in marines as private, rose to major; U. S. congressman 1905–11.

Dendera (*dĕn'dēr-ă*), Egypt, a village in Upper Egypt, on the left bank of the Nile opposite Kena; seat of the beautiful temple of Athor, built in the first century B.C.

Den'drite, a branched process from a nerve cell B-282, N-111, *picture* N-111

Dendrology, science of trees T-185

Den'eb, a star, of the first magnitude in the constellation of Cygnus S-372, *charts* S-377–8, 381

Denfeld, Louis Emil (born 1891), U.S. Navy officer, born Westboro, Mass.; in World Wars I and II; assistant chief Bureau of Naval Personnel 1942–45, chief 1945–47; chief of naval operations 1947–49.

Dengue (*dĕng'gā*), disease M-402

Denier (*dē-nēr'*), a unit of weight for yarns F-9

Den'iker, Joseph (1852–1918), French naturalist and anthropologist, born Astrakhan, Russia; wrote 'Races of Man' and other important ethnological and zoological works.

Denikin (*dyin-yē'kin*), **Anton** (1872–1947), Russian general on general staff in early part of World War I; after revolution followed Kornilof, later becoming anti-Bolshevik Cossack commander operating between Caspian and Black seas 1919: W-240–1, R-289

Den'im, a heavy, cotton twilled fabric, usually colored; coarser weaves are used for overalls, etc.; finer, for drapery and upholstery. Name comes from French town of Nimes ("serge de Nimes").

Denis, Saint (*sānt dĕn'is*, French *săn dē-nē'*) (Latin *Dionysius*), apostle to the Gauls (A.D. 250?), first bishop of Paris, martyr and a patron saint of France; legend says he ran carrying his head in his hand after he was beheaded for his faith by order of the Roman governor; festival October 9; abbey near Paris burial place of many of the kings of France.

Denis, Maurice (1870–1943), French artist, influenced by Gauguin; noted for murals which show influence of 15th-century Italian fresco painters; excels in religious art.

Denison, George Taylor (1839–1925), Canadian soldier and author, born Toronto; important in Canadian political life; lieutenant colonel; in active military service in 1866 during Fenian raids, and in 1885 during Riel Rebellion ('A History of Cavalry'; 'Soldiering in Canada'; 'The Struggle for Imperial Unity'; 'Fenian Raid at Fort Erie').

Denison, Tex., industrial town 65 mi n. of Dallas in rich farming section; pop. 17,504; railroad shops, cotton and flour mills, mattress and overall factories: *maps* T-90, U-252–3

Denison Dam, in Oklahoma and Texas, on the Red River, *maps* O-371, T-90. *See also in Index* Dam, *table*

Denison University, at Granville Ohio; founded 1831; arts and sciences, music, Air Force ROTC.

Denmark, one of the three Scandinavian kingdoms of n.w. Europe; 16,568 sq. mi.; pop. 4,281,275; cap. Copenhagen: D-68–72, S-55, *maps* D-71, E-416, 424, *pictures* D-68–9, *Reference-Outline* D-72. For a list of rulers of Denmark, *see table* on this page
- agriculture D-68, 70
- bibliography D-72
- Christmas C-294*a*–*b*, 299
- cities D-70, *list* D-68
- Copenhagen C-472

nephews to Frankish kingdom at tacked popes territory and was captured by Charlemagne

Design *See also* in *Index* Carving Clothing Drawing *Enameling* Furniture Glass Jewelry and gems Metalwork Painting Porcelain and chinaware Sculpture Tapestry Textiles *subhead* design Woodworking and wood carving

Aegean art *picture* A 28

American Colonies *See in Index* American Colonies *subhead* arts and crafts

bookbindings B 241 *pictures* B 240

book illustration L 267–17 L 269 75 *pictures* L–269 271 273–5 *See* below *subhead* illuminated books

bookplates B 247, *picture* B 388

bricklaying B 304

Chinese C 277–8

crystals *picture* C 525

dress laws and principles D 148–9

Egyptian *pictures* A 298 D 14c P 24 P 319c, *color picture* S 72

Greek and Roman *pictures* G 203–7 R 185

Huaxtec art, *picture* I 109

illuminated books manuscripts B 236 *pictures* B 236 237 239 *color pictures* B 233 234

Indians of America baskets B 74 *pictures* B 73

lace *pictures* L 77 78 79

lotus L 317 T 104

oriental rugs R 248 *color picture* I 249

Paisley shawls origin *picture* R 156

posters *pictures* W 236 237

sun and mountain design *picture* B 78

wallpaper W-4–5 *picture* I 184

Desk

Laurentian Library *picture* L-183

medieval *picture* R 231

Desman (*dĕz măn*) name of two species of aquatic insect eating animals closely related to moles One species Russian desman lives in s e Europe and w Asia head and body about 10 in long tail 7 in fur reddish brown above grayish white with silvery sheen below tail laterally compressed almost entire length scientific name *Desmana moschata* The other species Pyrenean desman lives in Spain and France about 10 in long (half of this is tail) chestnut above silver gray below flanks brownish gray last quarter of tail laterally compressed scientific name *Galemys pyrenaicus*

De Smet Pierre Jean (1801 73) Jesuit missionary b in Termonde Belgium came to U S in 1821 and entered the Jesuit order at Baltimore first mission 1838 at site of Council Bluff Iowa among Potawatomi began his work in the Far West 1840 known as *Blackrobe* among the Indians he made peace between tribes and between Indian and white man mediated "Mormon War and Yakima Indian War in 1858 visited and pacified Sitting Bull despite the latter's oath to kill the first white man to appear in his camp

Desmids minute one cell fresh water algae bright green in color divided into symmetrical halves order *Desmidiaceae* picture L 224d

Des Moines (*de moin*) state capital and largest city of Iowa *pop 177* 965 D 73b *maps* I 214, U 253

Capitol State *picture* I 220 murals *picture* U 389

government M 451

'Des Moines, *cruiser* N 86 *picture* N 85

Des Moines River rises in s w Minnesota and flows 450 mi s e through Iowa to Mississippi River *maps* I 208 214–15 M 287 U 288

Desmoulins (*dā mŏo lăn*) **Camille** (1760–94) French political leader and journalist his crying To arms as the news of Necker's dismissal reached the Paris crowds (1789) initiated French Revolution he became alienated from Jacobins guillotined his wife Lucile guillotined a week later (April 13)

Desolation (Spanish Desolación) **Island** an island of Tierra del Fuego belonging to Chile near w end of Strait of Magellan name also applied to Kerguelen Land *map* S 253

Desor Édouard (1811 82) Swiss geologist worked with Agassiz professor Academy of Neuchâtel (books on geology of Switzerland)

De Soto (*dĕ sō tō*) **Hernando** (1500? 1 42) Spanish explorer of s e U S and discoverer of Mississippi River D 73b–4 A 190 *maps* U 378 F 151

Alabama A 120

Arkansas A 369

Missouri M 323

De Soto National Memorial in *Florida* N 38d

Despenser Hugh le the Elder (1262–1326) English nobleman powerful wealthy leader of the Barons party opposing Edward II almost alone opposed execution of Gaveston later himself chief adviser and favorite of king arrogance and rapacity of his son Hugh the Younger (died 1326) largely responsible for their fall and hanging

D'Esperey Louis Franchet *See in Index* Franchet d'Esperey Louis

Despiau (*dĕs pē o*) **Charles** (1874–1946) French sculptor best known for sensitively modeled portrait busts of women S 81

Des Plaines Ill city 20 mi n w of Chicago on Des Plaines River pop 14 994 greenhouses machine shops ceramics truck farming railway center O'Hare International Airport nearby city founded 1835 *map inset* I 38

Des Plaines River in s e Wisconsin and n e Illinois joins Kankakee to form Illinois River length 150 mi part of course used by Illinois Waterway C 231a *map* I 38

Dessalines (*dā sa lēn*) **Jean Jacques** (1758–1806) Jean Jacques I emperor of Haiti (1804 6) Negro slave insurrectionist general under Toussaint L'Ouverture and barbarian despot assassinated H 248

De Stijl (the style) art movement P 38

Destinn Emmy (*Ema Kittl*) (1878–1930) Bohemian operatic soprano born Prague debut 1898 at Berlin won world wide reputation appearing Europe and U S created title roles in Madame Butterfly and The Girl of the Golden West

Destroyer a naval vessel N 86–7 S 438 *pictures* N 86 W 227

United States how named *table* N 82

Destroying angel a poisonous mushroom *See in Index* Amanita

Détaille (*dā ta yu*) **Jean Baptiste Édouard** (1848–1912) French painter born Paris France renowned for his vivid and accurate paintings of military subjects (Defense of Campigny Movement of Troops)

Detective dictograph device for trapping criminals D 69

Detectives police division P 334 355a

Detective story in American literature A 226f

Edgar Allan Poe P 331

Detector radio device for rectifying high frequency currents in radio receivers

crystal R 36 *diagram* R 35

superheterodyne *diagram* R 39

vacuum tube P 37–8

Detector supersonic to detect submerged submarines S 438

Deterding (*dā tĕr dĭng*) **Sir Henri Wilhelm August** (1866–1939) Dutch oil magnate and international oil operator born Amsterdam with Royal Dutch Oil Co and Asiatic Petroleum Co director of other companies supported the Hitler Nazi movement in Germany

Detergents cleansing agents S 213 214 L 284–5 *diagram* L 263

Determinism the philosophical doctrine that ethical choices are determined or prescribed by mental physical and environmental causes opposed to the doctrine of free will

Determinism economic C 425–6

Detmold Germany small city at edge of Teutoburger Wald 47 mi s w of Hanover nearby was erected a colossal statue of Hermann or Arminius who defeated Romans A D 9

Detonation explosion E 457 8

Detroit Mich city on Detroit River pop 1 849 568 automobile capital of the world D 74–6 *maps* U 253 *inset* M 227, *pictures* D 74–6

Ambassador Bridge *picture* D 74 *See also in Index* Bridge *table*

automobile industry D 74–5 beginning A 504

Cadillac founds C 10

history D 75 War of 1812 W 13

Institute of Arts *See in Index* Museums *table*

Flannagan's The Frog S 82 *picture* S 82

Rivera's fresco P 37a *color picture* P 36

library record room *picture* L 189

natural gas pipelines G 33

population growth D 74 75 *charts* G 165

zoo Z 360 D 75–6

Detroit University of at Detroit Mich Roman Catholic founded by Jesuits 1877

Detroit Dam in Oregon on the North Santiam River *See also in Index* Dam *table*

Detroit Lakes Minn resort town 49 mi e of Fargo N D on Detroit Lake and near many other lakes pop 5787 center of farm trade *map* M 286

Detroit River connecting Lake St Clair and Lake Erie D 75 *maps* M 219 G 179 *inset* M 227 *pictures* D 74 75

bridge *picture* D 74 *See also in Index* Bridge *table*

vehicular tunnel D 76

Dett Robert Nathaniel (1882–1943) American Negro pianist and composer born Drummondville Ontario Canada organized Hampton Institute Choir piano and choral compositions based on Negro folk tunes (Magnolia Suite The Chariot Jubilee In the Bottoms America the Beautiful) Publisher Dett Collection of Negro Spirituals

Dettingen (*dĕt ĭng ĕn*) village of Bavaria Germany on River Main decisive victory of Allies under George II of England over French under Duc de Noailles, June 27 1743

Deucalion (*dū kā lĭ ŏn*) the Noah of Greek mythology D 76 M 476

Deuterium H 459 M 476a *picture* R 54a

of education into effect in children s school connected with University of Chicago 1894–1904 professor of philosophy at Columbia University 1904–30 profoundly influenced education and modern philosophy (School and Society Reconstruction in Philosophy Human Nature and Conduct How We Think Democracy and Education The Quest for Certainty Art as Experience Freedom and Culture) P 426
influence on education E 247 253
Dewey Melvil (1851–1931) librarian born Adams Center N Y founder of the *Library Journal* and one of the founders of the American Library Association inventor of decimal classification L-187
Dewey Thomas Edmund (born 1902) lawyer born Owosso Mich notable success as special prosecutor of racketeering gangs in New York City 1935–37 district attorney of New York Co 1937–42 governor of New York 1942–54 Republican presidential nominee 1944 1948
Dewey decimal classification L 204–6
Dewing Thomas W (1851–1938) figure and portrait painter born Boston Mass paintings usually small treatment refined color delicate
De Witt (*dĕ vit*) **Jan** (1625–72) Dutch statesman grand pensionary for nearly 20 years supported republicans against House of Orange sought alliance with Louis XIV lost influence when French designs against Netherlands became apparent killed by mob with his brother Cornelius N 121
DeWitt (*dĕ wit*) **Clinton**, first locomotive operated in New York state made initial run from Albany to Schenectady Aug 9 1831 over Mohawk and Hudson Railroad (now part of New York Central Railroad)
Dew point D 77
hygrometer H 461
Dewsbury England town in Yorkshire 8 mi s of Leeds pop 53-4 6 carpets blankets worsteds *map* B 325
Dexter Timothy (1747–1806) eccentric merchant born Malden Mass set up shop as leather dresser in Newburyport 1770 bought up cheap Continental currency which made him rich in 1791 engaged in shipping and speculative enterprises with enormous profit bought mansion where he lived as a self styled lord (Lord Timothy Dexter by John P Marquand)
Dextrin an adhesive gum D 77
uses S 382 *diagram* C 483
Dextrorotation of polarized light rotation of plane polarized light to the right L 235
tartaric acid exhibits T 21
Dextrose grape sugar or **glucose** *See in Index* Glucose
Dey title of Turkish rulers of Algeria before the French conquest in 1830
Dezhneva (*dĕzh nĕ vă*) **Cape** or **Dezhnev** (*dĕzh nĕf*) **Cape** also **East Cape** easternmost point of the continent of Asia in Siberia on Bering Strait *maps* A 406 411 *picture* A 413
Dhole (*dōl*) wild dog of India (*Cuon dukhunensis*) usually rusty red in color differs from wolf in having hair between toes and in having shorter muzzle
Dhoti (*do tē*) loincloth worn by Hindu men may be thigh or ankle length I 61 *pictures* I 59 61
Dhow (*dou*) an Arab vessel *picture* A 289
Dhu Roderick an outlaw chieftain in Sir Walter Scott s Lady of the Lake
Diabase or **greenstone** a granular igneous rock with lime soda feldspar and pyroxene (augite) as its essential minerals generally crystalline throughout almost identical with basalt
Diabetes (*dī a bē tē*) disease D 105 H 426 425
Banting and Best discover insulin B 53
Diablo Canyon in Arizona *See in Index* Canyon Diablo
Diablo (*dē ab lo*) **Mount** a peak of the Coast Range in California is about 30 mi e of San Francisco (3856 ft) commands wide view
Diablo Dam in Washington on the Skagit River *map* W 44 *See also in Index* Dam *table*
Diaghilev (*dya gĭ lĕf*) **Sergei Pavlovich** (*syâr gā ĭ pav lŏ vĭch*) (1872–1929) Russian ballet and opera producer revolutionized art of ballet D 14; B 28a
Diagnosis of diseases M 164
Diagraming in grammar G 149
Dial watch how made W 68
Dial The organ of the transcendental movement E 339
Dialect in language L 98a
Dial lock L-289
Dial telephone system T 41–4 *diagrams* T 42
Diamantina (*dī a măn tē na*) **River** in s w Queensland Australia *maps* A 489 478
Diameter a line or length of a line through or across the center of a plane or solid from Greek *dia* through and *metron* measure
circle M 150
earth *diagram* F 172
sun and planets *diagram* P 283 *table* P 283
Diamond a gem D 78 81 *pictures* D 79–81 *color pictures* J 347–8
birthstone *color picture* J 348
cutting and polishing D 78 *pictures* D 81 cuts for modern jewelry
pictures D 79 J 350
engagement ring M 101b
famous diamonds D 80–1 *pictures* D 79
largest Cullinan D 81
man made D 78
mining D 80 *diagram* D 80
producing regions D 78 80 Africa D 78 C 434f F 198 A 44 Arkansas A 360 Brazil B 291
qualities of D 78
relative hardness M 261
uses other than as gems D 78 rock drill M 268 *picture* D 81 wire dies W 163 D 78
Diamond baseball F 65 *diagram*
B 64 *picture* B 64
Diamond Cape on St Lawrence River at Quebec Q 9 10
Diamondback rattlesnake R 78
Diamondback terrapin found in salt water color brown or olive concentric grooves on shell (*Malaclemys centrata*) T 224 *picture* T 223
Diamond ball B 72
Diamond flower *See in Index* Ionopsidium
Diamond Head Hawaiian Islands promontory on se coast of Oahu Island 761 ft Hawaiian National Guard base *map* H 286
Diamond Necklace Affair historic French political scandal contributing to French Revolution and in which Marie Antoinette in whose name the necklace had been fraudulently ordered through certain
swindlers and their dupes
Diamond State popular name for Delaware D 49
Diamond type in printing T 228
Diana (*dī an a*) goddess in Roman mythology identified with Greek Artemis A 389 *pictures* F 445 S 81 *See also in Index* Artemis
Diana Temple of at Ephesus S 105 *picture* S 105
Diana monkey M 351
Dianthus a plant P 259
Diaphragm (*dī a fram*) camera P 222–3
Diaphragm in anatomy D 81 L 351 P 244 H 3 a s D 91 L 361 *picture* N 113 *color picture* P 240–3
Diaphragm phonograph P 207
Diary a daily personal record D 82
Dias (*dē as*) **Antonio Gonçalves** (1823 64) Brazilian poet L 126
Diascia (*dī ash ī a*) a genus of annual and perennial plants of the figwort family native to Africa **Twinspur** (*D barberae*) has flowers in clusters rose pink with yellow spot in throat and 5 lobes (petals) the lower has 2 spurs hence the name attached 2 spurs hence the name
Diaspora dispersion of Jews I 256
Diaspore (*dī a spōr*) native hydrated aluminum oxide
high alumina brick B 304
Diastase an enzyme in malt M 60 L 389 *table* E 389
Diastole (*dī as tō lē*) relaxation of heart H 313
Diastolic blood pressure D 210
Diathermy I 41
Diatom (*dī a tŏm*) a single celled water plant having a siliceous shell D 82 *pictures* M 233 A 236b L 224b
Antarctic regions A 260
deposits F 248 O 332
fish attracted by F 100
place in food chain *picture* F 100
Diatomaceous earth *See in Index* Tripoli powder
Diatomite fossil remains of diatoms F 248
Diatonic scale *In Index* Music *table* of musical terms and forms
Diavolo Fra (*fra dē ă vō lō*) (Brother Devil) (1771 1806) Italian brigand and renegade monk subject of opera by Auber
Diaz (*dē ash*) or **Dias de Novaes Bartholomeu** (1450? 1500) Portuguese navigator discoverer of Cape of Good Hope D 82–3 C 118
Diaz (*dē as*) **Eduardo Acevedo** (1851–1921) novelist of Uruguay L 128
Diaz de la Peña (*dē as dĕ lä pān yä*) **Narcisse Virgile** (1807–76) French landscape and figure painter born Bordeaux France of Spanish parents member of Barbizon School
Diaz (*dē as*) **Porfirio** (1830–1915) president of Mexico D 83 M 200 206 7
Dicentra (*dī sĕn tra*) a genus of perennial plants of fumitory family native to North America and Asia has much cut foliage and clusters of rose yellow or white flowers in cluding squirrel corn (*D canadensis*) golden eardrops (*D chrysantha*) bleeding heart (*D spectabilis*) and Dutchman s breeches (*D cucullaria*)
Dichlorodiphenyl-trichloroethane (DDT) I 164
Dichlorophenoxyacetic acid (weed killer) W 64
Dick George Frederick (born 1881) physician and bacteriologist born Fort Wayne Ind professor of medicine University of Chicago after 1933 with wife Gladys H

studied with X rays X 330
time required D 91a
Diggers Indians of various tribes who lived in the deserts of western U S they ate roots and lived in caves and grass huts
Digger wasp W 53 picture W 53
Digit a single numerical figure N 312a
Digitalis *See in Index* Foxglove
Digitigrade (*dĭj ĭ tĭ grād*) animals toe walkers F 224
evolution H 428i
Dihedral angle of airplane A 89 *diagram* A 87 *See also in Index* Aviation *table* of terms
Dijon (*dē zhôn*) fortified town in e France former capital of Burgundy pop 92 257 fine churches university various manufactures mustard wine occupied by Germans in 1870 and in 1940 *maps* F 259 270 E 425
Dika nut seed of the wild mango of West Africa source of oil
Dik dik African antelope A 262
Dike or **dyke** embankment usually to protect lowlands from floods
Guiana G 222d
Holland N 116 *pictures* N 118 119 I 253
Hwang River China H 454
levees R 156 M 308 *picture* E 219
Mississippi River M 308
New Brunswick N 138a
sea walls G 7
Dike in geology F 187 *diagram* G 49
Dikh Tau (*dĭk tou*) also **Dykhtau** Mount in central Caucasus 17 085 ft *map* P 287
Diligenti quintuplets (born July 15 1943) children of Franco and Ana Maria Diligenti born Buenos Aires Argentina combined weight at birth about 10 pounds two boys (Franco and Carlos Alberto) and three girls (Maria Ester Maria Fernanda and Maria Cristina) second known quintuplets to survive more than one hour *See also in Index* Dionne quintuplets
Dill plant of parsley family S 341
Dillard University, at New Orleans La founded 1935 arts and sciences
Dillenius or **Dillen** Johann Jakob (1687–1747) German English botanist born Darmstadt Germany first professor of botany at Oxford University (Historia Muscorum book on mosses)
Dillon George (born 1906) poet born Jacksonville Fla associate editor of *Poetry* a magazine of verse while student at University of Chicago Pulitzer prize for poetry (1931) Guggenheim fellowship (1932–33) editor of *Poetry* 1937–49 with leave for military service (Boy in the Wind The Flowering Stone)
Dillon John (1851–1927) Irish Nationalist political leader born Dublin worked to abolish British rule in Ireland imprisoned several times member of Parliament more than 30 years political activity waned on rise of Sinn Feiners 1918
Di Maggio Joseph Paul Jr (Joe) (born 1914) professional baseball player born San Francisco Calif entered major league baseball in 1936 as center fielder for New York Yankees achieved fame as fielder batter and all around player retired Dec 1951
Dime a U S silver coin worth 10 cents or 1/10 of a dollar term once meant the tenth part the tithe paid as church or state dues Wycliffe s Bible translation reads He gave him dymes of alle thingis

Dimeter line in poetry P 335
Diminuendo *See in Index* Music *table* of musical terms and forms
Dimitrov (*dē mē trôf*) Georgi (1882–1949) Communist official born Bulgaria accused of complicity in setting fire to Reichstag 1933 on trial defied Hermann Goering and was found not guilty secretary general of Communist International (Comintern) 1935–43 premier of Bulgaria 1946–49
Dimity a fine cotton fabric with corded stripes or bars name originally applied to heavy fabric of same type made in Spain for bed hangings
Dimnet (*dem ne*) Ernest (1866–1954) French abbé canon of Cambrai Cathedral born Trélon in France popular in U S as lecturer (The Bronte Sisters The Art of Thinking What We Live By My Old World and My New World autobiography)
Dimorphotheca (*dī mor fō thē ka*) a genus of annual and perennial plants and shrubs of the composite family native to s Africa flowers yellow purple or white rays with contrasting centers they close toward sundown also called cape marigold or African daisy
Dinant (*dē nän*) town in Belgium on Meuse River 48 mi s e of Brussels pop 6925 once noted for copperware sacked by Burgundians in 1466 by French 1554 1675 captured and burned by Germans Aug 23 1914 *map* B 111
Dinar (*dē när*) a monetary unit of Yugoslavia Iraq and Trans Jordan historic value of Yugoslavian coin about 19 cents also a *medieval gold coin of Arabia* and other Moslem lands worth about $4 00
Dinaric Alps mountains in w Yugoslavia highest point Dinara (6008 ft) B 21 *maps* D 16 B 23 E 419 425 *picture* Y 347
D Indy Vincent *See in Index* Indy Vincent d
Ding J N *See in Index* Darling Jay Norwood
Ding Dong School *See in Index* Horwich Frances R(appaport)
Dinghy *See in Index* Nautical terms *table*
Dingle wonigan stick or tea stick C 62 *picture* C 61
Dingley Nelson Jr (1832–99) statesman and journalist born Durham Me editor and publisher *Lewiston (Me) Journal* member of Congress 1881 99 framed protective Dingley Tariff Act of 1897
Dingley Tariff Act (1897) T 18
Dingo Australian wild dog A 479 *picture* D 116d
Dinka a group of Negro tribes in the Sudan along the White Nile River a tall race with skins almost blue black the men raise cattle while the women till the soil S 442 *picture* S 442
Dinkelsbühl (*dink els bul*) Germany picturesque old town in Bavaria on river Wörnitz 22 mi s of Rothenburg on the Tauber founded 10th century free imperial city 1351 1802 contains medieval walls and towers also the German House example of German Renaissance wooden architecture
Dinking machine shoemaking *picture* S 165
Dinmont Dandie in Sir Walter Scott s Guy Mannering a rough shrewd humorous Scottish farmer from whose dogs are named the Dandie Dinmont breed of Scottish terriers
Dinosaur extinct reptile R 111–18

P 408b *pictures* R 112 114 115 116 P 406a c
eggs R 112 *picture* F 244
fossil tells geologic time *picture* G 52
fossilized bones in Dinosaur National Monument N 33
groups and orders R 116
size compared with whale *picture* W 113
tracks in fossilized mud flats *picture* F 247
Dinosaur (*dī nō sąr*) **National Monument** in Utah and Colorado N 33 *maps* N 18 C 408
Dinwiddie Robert (1693?–1770) British official lieutenant governor of Virginia 1752 58 strenuous supporter of French and Indian War Washington and W 18
Diocese the district of the churches presided over by a bishop in Roman times was a civil division of territory but as the early church developed along the same territorial divisions the word gradually became ecclesiastical
Diocletian (*dī ō klē shan*) (245–313) Roman emperor (284–305) able soldier and energetic ruler under whom a memorable persecution of Christians took place R 188
baths of R 195 *map* R 191
Christian persecutions C 301–2
palace ruins Split, Yugoslavia *picture* B 27
Diode (*dī ōd*) a type of vacuum tube R 317 *diagrams* E 317
Diodorus Siculus (died about 20 B C) Greek historian of time of Julius Caesar and Augustus of his Historical Library history of world in 40 books only parts remain
Dioecious (*dī ē shŭs*) plants P 185
Diogenes (*dī ŏj e nēz*) (412 323 B C) Greek Cynic philosopher D 92 *picture* D 92
Diomede (*dī ō mēd*) **Islands** two islands in Bering Strait between Asia and N America Big Diomede belongs to Russia Little Diomede 3½ mi s e to the United States separated by international date line remains of prehistoric migration of Eskimos from Asia to America *map* A 135 *picture* A 413
Diomedes (*dī ō mē dēz*) in Greek mythology king of Thrace H 342
Diomedes one of Greek heroes of Trojan War
aided by Athena A 446
wounds Aphrodite A 274
Dionaea also **Dione** (Aphrodite) A 274
Dionne (*dē ŏn*) **quintuplets** (born 1934) daughters of Oliva and Elzire Dionne born May 28 at Callander Ont combined weight at birth about 13 pounds names Annette Cecile, Emilie (died 1954) Marie Yvonne first known quintuplets to survive more than one hour Dr Allan R Dafoe (1883–1943) attending physician made king s wards by Ontario government 1935 returned to father 1944
Dionysius the Elder (432?–367 B C) tyrant of Syracuse cruel despot pardons Damon and Pythias D 13
Plato sold as slave by P 315
sword of Damocles D 13
Dionysus in Greek mythology D 93
Greek festivals D 129–30
Midas M 236
Praxiteles statue of Hermes and Infant Dionysus G 204–5 S 77, *picture* S 77
theater of T 110
Diophantus (3d century A D) Greek mathematician of Alexandria known as the father of algebra (principal work Arithmetica)
Diopside (*dī ŏp sīd*) a transparent to opaque calcium magnesium sili

Dixie Highway, popular name for two north-to-south highways beginning at Sault Ste. Marie, Mich., and terminating in Florida. The "east" route goes through Saginaw, Detroit, Cincinnati, Asheville, Savannah to Miami; the "west" route through St. Joseph, Indianapolis, Louisville, Chattanooga to Jacksonville. In addition, the Dixie Bee Line Route goes from Chicago to Nashville, Tenn., and the Dixie Overland Highway from San Diego, Calif., to Savannah, Ga.

'Dixmude', French airship B-34

Dixon, Jeremiah (died 1777), English surveyor who helped fix Mason and Dixon's line M-123

Dixon, Thomas (1864–1946), novelist and playwright, born Shelby, N.C. ('The Leopard's Spots'; 'The Clansman').

Dixon, Ill., city on Rock River, 98 mi. w. of Chicago; pop. 11,523; shoes, wire screen, dairy products, cement: *map* I-36

Diyarbakir (*dē-yär-bä-kir'*), also **Diyarbekir** (*dē-yär-bĕ-kir'*), Turkey, town on Tigris River about 200 mi. n.e. of Aleppo; pop. 45,495; silk goods, gold and silver filigree work: *maps* A-406, T-215

Djakarta, Indonesia. *See in Index* Jakarta

Djerba, or **Jerba** (*ġĕr'bą*), island belonging to Tunisia, off e. coast, in Gulf of Gabes; about 16 mi. long by 16 mi. wide; pop. 59,331; olive oil and dates exported; in Greek and Roman geography, the lotus-eaters' island.

Djibouti, or **Jibuti** (*ġi-bo'ti*), chief port and capital of French Somaliland, in n.e. Africa; pop. 17,500: E-402, *maps* E-402, A-46, A-285

Djokjakarta (*yōk-yä-kär'tą*), Indonesia, city in s.-central Java; pop. 500,000: *maps* E-202, A-407, *picture* J-327

Djoser, or **Zoser**, king of Egypt (2700 B.C.) E-279

Dmitri (*dmē'trē*), or **Demetrius** (*dē-mē'tri-ŭs*), Russian pretender who appeared 1603 and took name of heir to the throne, who had been secretly killed by the usurping czar Boris Gudenov; reigned ably until his murder (1606); followed by a series of less able "false Dmitris": R-285

Dnepropetrovsk (*d'nyĕ-prō-pyĕ-trôfsk'*), Russia, formerly **Ekaterinoslav** (*yĕ-kät-ĕr-ēn-ō-slaf'*), trade city in the Ukraine near site of great dam on Dnieper River, 250 mi. n.e. of Odessa; pop. 500,000; iron and steel products, flour; timber depot: *maps* R-267, E-417
- dam, *picture* R-290

Dnieper (*nē'pĕr*), Russian **Dnepr** (*d'nyĕ'p'r*), large navigable river of w. Russia; rises s.e. of Smolensk and flows s.e. and s.w. 1410 mi. to Black Sea; fisheries: *maps* R-259, E-417, 419, B-204
- Cossacks C-489
- early commerce R-284

Dnieper Dam, in Russia, on Dnieper River, 200 miles from its mouth, between Dnepropetrovsk and Zaporozhe, Ukraine; concrete dam with 3 locks; generates 900,000 h.p.; construction directed by American engineers and cost about $110,000,000; blown up by Russians 1941 in retreat from Germans who repaired dam but destroyed it again 1943; rebuilt 1947: *picture* R-290. *See also in Index* Dam, *table*

Dniester (*nēs'tĕr*), Russian **Dnestr** (*d'nyĕs't'r*), river of s.e. Europe; rises in Carpathian Mts., flows s.e. 865 mi. to Black Sea; rich in fish: *maps* R-259, D-16, E-417, 419

Doane College, at Crete, Neb.; Congregational; established 1872; liberal arts

Dobbin, Major, in William Makepeace Thackeray's 'Vanity Fair', lifelong friend of George Osborne and patient suitor of Osborne's widow, Amelia, whom he finally marries.

Dobby, in weaving F-7

Dobell (*dō-bĕl'*), **Bertram** (1842–1914), English bookseller and poet, born Battle, England; arranged publication of James Thomson's 'The City of Dreadful Night'; identified and edited poetry of Thomas Traherne

Döbereiner (*dû'bĕ-ri-nĕr*), **Johann Wolfgang** (1780–1849), German chemist, born near Hof, Bavaria; invented Döbereiner's lamp, ignited by action of hydrogen on platinum sponge and widely used before prevalence of sulfur match; discovered furfural; in chemistry, classified similar elements in groups of three (Döbereiner's triads)

Do'berman pinscher, a smooth-coated muscular dog, *color picture* D-116a, *table* D-118a
- war service D-110a

Dobie, J. Frank (born 1888), author and educator born Live Oak County, Tex., professor of English, University of Texas 1933–47, popular, authoritative legends of Southwest ('Coronado's Children'; 'Tales of the Mustangs'; 'The Longhorns').

Dobruja (*dō-brų'ją*), farming district in s.e. Europe on Black Sea, area 9000 sq. mi.: R-253, 254, B-350

Dobson, Austin (1840–1921), English poet and essayist; light satire, and graceful treatment of artificial French verse forms ('Proverbs in Porcelain'; 'Old World Idylls'; 'At the Sign of the Lyre')
- quoted W-190b

Dock, coarse weedy herbs comprising the genus *Rumex* of the buckwheat family; from 2 to 4 ft. high with small greenish flowers in panicles; leaves long and lance-shaped: *color picture* F-180

Dock, space for a ship between two adjoining piers or wharves; in America often called a "slip"; also an enclosed space for ships, with gates to maintain desired water level regardless of tides: *pictures* H-264, 265, S-149. *See also in Index* Harbors and ports
- dry dock H-265
- floating dry dock, *pictures* H-264, N-93
- modern equipment, *picture* N-182
- Saint John, New Brunswick, extreme tides, *pictures* T-131
- wet dock H-264, L-277: London, England, *picture* H-265

Doctor, a university degree U-400
- origin U-404

Doctor, medical. *See in Index* Medicine and surgery; Physician

Doctorfish, a fish of the genus *Teuthis*, with knifelike movable spine on each side of tail; also known as surgeonfish, lancet, barberfish, or tang; lives in warm seas.

Dod'der, a leafless parasitic plant introduced into U. S. from Europe with clover seeds; now a rapidly growing pest: P-80, *picture* P-294

Doddridge, Philip (1702–51), English nonconformist clergyman and hymn writer; wrote 400 hymns; distributed Bibles to the poor.

Dodecanese (*dō-dĕk-ą-nēs'*) (Greek for "12 islands"), group chiefly in s.e. Aegean Sea off Turkey; now numbers 14 instead of 12 main islands, including Rhodes, Cos, and Castelrosso; 1035 sq. mi.; pop. 112,676; ceded by Turkey to Italy 1924; ceded by Italy to Greece 1947: *maps* B-23, G-189

Dodge, Grace Hoadley (1856–1914), social worker, born New York City; organized (1884) the Industrial Education Association for the introduction of industrial education into public schools; helped to found Teachers College of Columbia University 1889; worked for many years with Y.W.C.A.

Dodge, Grenville Mellen (1831–1916), civil engineer and Union general in Civil War, born Danvers, Mass.; chief engineer Union Pacific Railroad 1866–70; Republican representative from Iowa 1867–69: C-228

Dodge, Mary Mapes (1831–1905), editor and writer for children, born New York City; editor of *St. Nicholas*; wrote 'Hans Brinker, or The Silver Skates'; 'The Land of Pluck': L-274–5

Dodge ball, a game, *picture* G-8b

Dodge City, Kan., city on Arkansas River, 150 mi. w. of Wichita; pop. 11,262; railroad shops; flour milling, creameries; renowned frontier town of early days: *map* K-10

Dodgson, Charles Lutwidge. *See in Index* Carroll, Lewis

Do'do, an extinct bird D-109, *picture* D-109

Dodo'na, Greece, city of ancient oracle D-62, *map* G-197

Dods'ley, Robert (1703–64), English author and publisher ('Select Collection of Old Plays'; 'The Muse in Livery'); suggested, published, and helped finance Johnson's dictionary.

Doe, John. *See in Index* John Doe

Doe, female of deer, antelope, hare, rabbit, kangaroo, and most other animals whose male is called buck.

Doenitz, Karl (born 1891), German submarine expert; made commander in chief of German navy 1943; succeeding Hitler, was Fuehrer May 1945; sentenced to 10 years' imprisonment for war crimes 1946.

Doering, William von Eggers (born 1917), chemist, born Fort Worth, Tex.; became chemistry instructor Columbia University 1943; with Robert Burns Woodward, in 1944, first to synthesize quinine.

Dog. *See in Index* Nautical terms, *table*

Dog D-110–20, *pictures* D-110–17, *color pictures* D-111–16b, *table* D-118–19. *See also in Index* dogs by name
- American Kennel Club D-120: breeds and standards, *table* D-118–19
- ancestors and relatives D-110, 117, 120, *pictures* D-116d–17
- armor for, *picture* A-376
- behavior and habits D-110, 116c–d
- body and life processes D-116d, *picture* D-110b
- books about H-392
- breeding D-110, 120
- breeds and standards, *table* D-118–19
- care as pet D-110, 117, *pictures* P-182a, D-116d: Boy Scouts learn first aid for, *picture* H-443; fleas, extermination of F-142
- domestication D-110: American Indians I-108c
- draft animal D-110, *pictures* D-110a: Belgium, *picture* B-113; Eskimo E-394, D-110, *picture* D-110a; sled dog of the north D-110, *pictures* D-110a, P-350a, P-386
- experiment on reflex R-90
- eye, *picture* E-461
- field trials D-120

Dover, Robert (1575–1641) English captain and attorney, founded and directed the Cotswold games as a protest against the Puritanism of his day; games comprised wrestling, jumping, gymnastics, rural dances

Dover, Del., state capital 55 mi s of Wilmington; pop. 6223 D 125, D 58, maps D 53, U 253
Capitol, State, picture D 48

Dover, England, port on English Channel; pop. 35,217 D 125–6, map B 325
harbor H 284

Dover, N.H., city on Cocheco River 8 mi n.w. of Portsmouth; pop. 15,874; shoes, printing machinery, fiber products, electrical equipment; early settlement (1623) map N 151

Dover, N.J., town 20 mi n.w. of Paterson; pop. 11,174 map N 164

Dover, Strait of, channel connecting North Sea with English Channel and separating England and France, 20 to 27 mi wide; chalk cliffs on both sides maps B 321, F 259, E 424–5, picture L 346

Doves Press, noted English printers
Bible specimen page picture P 239
book binding design picture B 240

Dovre Mountains, or **Dovrefjell** (dō-vru fyeld) range in central Norway; highest peak 7615 ft

Dow, Gerard. See in Index Douw, Gerard

Dow, Neal (1804–97) temperance orator, born Portland, Me., author of Maine prohibition law; Prohibition party candidate for president of U.S. 1880

Dowager, a widow with a dower; especially designates widow of titled person to distinguish her from wife of her husband's heir who has same title, as queen dowager

Dowden, Edward (1843–1913) British educator and literary critic, noted Shakespearean scholar; professor of English literature at University of Dublin 1867 until death ('Shakespere: His Mind and Art'; 'Poems'; 'Shakespeare Primer'; 'Life of Shelley')

Dowel. See in Index Architecture, table of terms

Dower, in law. See in Index Law, table of legal terms

Dowie, John Alexander (1848–1907) American religious leader, born Scotland; self-styled 'Elijah the Restorer'; preached faith healing; founded Christian Catholic church (1901) at Zion City, Ill.

Dowitcher, shore bird of family Scolopacidae; the dowitcher (Limnodromus griseus) is about 10½ inches long; ranges from Arctic regions of North America to n. South America S 209

Dowmetal table A 174

Down, a county of Northern Ireland in easternmost part of island of Ireland; land area 952 sq mi; pop. 241,105 I 231, map I 227

Down, a direction D 99–101, diagrams D 98, 99, 100

Down, plumage F 47, 48

Downers Grove, Ill., village 23 mi s.w. of Chicago; pop. 11,886 map, inset I 38

Downes, Olin (born 1886) music critic, born Evanston, Ill.; on Boston Post 1906–24, afterwards on New York Times; lecturer and writer on musical theory, history, and appreciation ('The Lure of Music')

Downhaul. See in Index Nautical terms, table

Downing Street, popular name for the British government, so called because both Foreign Office and the official residence of the prime minister are in Downing Street, London
No. 10 Downing Street, residence of prime ministers C 4, L 303, picture L 303

Downs, system of chalk hills in s.e. England; North Downs in Surrey and Kent, South in Sussex; after feeding ground for famous South-down sheep E 248, map B 321

Down under, a term used to designate the Antipodes—Australia, New Zealand, and the like; for example the man from down under

Downwind landing. See in Index Aviation, table of terms

Downs, mill lever M 249

Downy woodpecker W 188, color picture B 182
scientific name W 189

Dowser. See in Index Divining rod

Dowson, Ernest (1867–1900) English poet; hypersensitive, ill with tuberculosis and addicted to drugs and drink, lived lonely, unhappy life; best known for musical and delicate lyrics, most of which are colored with sadness; most famous poem popularly known as 'Cynara'

Doyle (doil), **Sir Arthur Conan** (1859–1930) British novelist, creator of famous detective character Sherlock Holmes. While practicing as physician he began to write detective stories. He served as medical officer in Boer War and wrote two books defending the British position. In World War I wrote propaganda for Allies; later devoted himself to spiritualism ('The White Company'; 'The Lost World'; 'The Complete Sherlock Holmes')
'Study in Scarlet, A' L 98b

D.P.'s. See in Index Displaced persons

Dracaena (drą sē'nạ) genus of perennial plants of lily family native to the tropics. Used as foliage plants because of broad or sword-shaped varicolored leaves. Dragon tree (D. draco) of Canary Islands grows to 60 feet; its dried juice supposed to resemble dragon's blood

Drachenfels (drä'ẖen fĕls) dragon's rock, mountain in Germany 10 mi s.e. of Bonn, 1065 ft high; castle

Drachma (drăk'mạ) Greek monetary unit; historical value about 2 cents; coined in nickel copper. In ancient Greece silver coin worth 9 to 17 cents

Drachmann (dräẖ'män), **Holger Henrik Herholdt** (1846–1908) Danish poet, dramatist, and short story writer ('Tendrils and Roses'; 'Once upon a Time' and 'Wayland the Smith', plays; 'The Sacred Fire', autobiographical work)

Draco (drā'kō) (7th century B.C.) compiler of first written code of Athenian laws G 198

Draco, a northern constellation charts S 374, 378–9
Alpha, pole star of Egyptians A 440

Draft
military conscription. See in Index Conscription
negotiable instrument C 609
ship picture S 161. See also in Index Nautical terms, table

Draft animals, animals used for drawing loads. See in Index Transportation, animal power

Draft horses H 425a, pictures H 425b, table H 425c

Drafting. See in Index Mechanical drawing

Drafting machine, mechanical drawing instrument M 157d, picture M 157a

Draft riots, New York City (1863) N 226

Drag, in fishing list F 118h

Drag, of a speeding object
airplane A 83, 87, diagram A 87. See also in Index Aviation, table of terms
streamlining overcomes S 427, pictures S 428

Draga (Mme. Draga Mashin) (died 1903) queen of King Alexander I (Obrenovich) of Serbia, formerly lady in waiting to his mother Queen Natalie; assassinated with king by group which opposed the marriage

Dragon, a breed of pigeons P 254

Dragon, fabulous animal D 126, picture F 194
Cadmus kills C 13
Chinese and Japanese myths D 126, C 278
Jason and A 338
St. George slays G 66, picture G 66
Siegfried and Fafnir S 177

Dragon, name of two kinds of lizard
dragon, or giant lizard L 284, picture L 282; discovery D 356
flying dragon L 284, D 126, picture L 283

Dragon Boat Festival, in China C 268, F 58, picture C 269

Dragonfly, devil's darning needle, or horse stinger D 126–8, pictures I 152, D 126–7, N 53, color picture I 154c

Dragon's blood, a reddish brown resin used in engraving P 210a, G 232

Dragon ship, of Northmen N 294, picture S 153, E 360

Dragon tree. See in Index Dracaena

Dragoon bird. See in Index Umbrella bird

Drags, position of riders driving a herd of cattle C 151

Drainage, land I 253. See also in Index Irrigation and reclamation

Drainage, plumbing P 323
building problems B 346

Drainage Canal, Chicago. See in Index Chicago Sanitary and Ship Canal

Drainage canals C 105

Drain pipes, tile B 305

Drais (drīs), **Karl** (1785–1851) German inventor of velocipede B 141

Drake, Edwin L. (1819–80) pioneer oil producer, born Greenville, N.Y. P 179–80, picture P 180

Drake, Sir Francis (1545–96) explorer and privateer, first English man to circumnavigate the globe D 128–9, pictures D 128, A 372
burns city of St. Augustine S 17
California C 45
captures Cartagena C-388
Oregon O 410
San Juan, Puerto Rico P 434
Spanish Armada defeated A 372–3
voyages A 190, D 128–9, maps M 33, A 189, picture D 128

Drake, Joseph Rodman (1795–1820) poet, born New York City; often used signature 'Croaker' ('The Culprit Fay'; 'The American Flag'); subject of Fitz-Greene Halleck's eulogy
Green be the turf above thee,
Friend of my better days;
None knew thee but to love thee,
Nor named thee but to praise

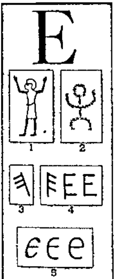
Drake, a male duck D 158

Drakensberg (drä'kĕns bĕrẖ) mountain range in s.e. Africa A 37, S 241, maps A 42, S 242
Natal N 14

Drake University, at Des Moines, Iowa; opened 1881; liberal arts, Bible, business administration, education, fine arts, law, pharmacy, graduate division

Drama D 129–37, A 400b–c, 400n–o, L 98c, pictures D 129–35, A 400f. See also in Index English literature, German literature, French literature, Motion pictures, Opera, Theater; also chief dramatists by name

viceroy of India 1884–88 and British ambassador to Russia Turkey Italy and France
Dufy (dü fē) **Raoul** (rä ōl) (1877–1953) French artist identified with the fauvists colorful and decorative landscapes impressions of cities life at the races noted also for tapestry and fabric designs ballet costumes murals and book illustrations
Du Gard Roger Martin *See in Index* Martin du Gard Roger
Dugong an aquatic herbivorous mammal related to the manatee M 71
Dugout in World War I *picture* W 229
Dugout primitive canoe C 114 N 142 *picture* B 218
wood used T 204
Dugout primitive dwelling *picture* A 205
Du Guesclin (dü gĕ klăN) **Bertrand** (1320?–80) French general under Charles V constable of France C 197 H 446
Duhamel (dü a mĕl) **Georges** (born 1884) French novelist poet and essayist born Paris studied medicine and served as surgeon in World War I had been known in literary circles for his essays and verse but first came to wide popular notice with his war books Les Vies des martyrs and Civilisation wrote Scenes from the Life of the Future after visit to U S
chief works F 291
Duisburg (dü is burK) Germany city on Rhine River north of Düsseldorf formerly Duisburg Hamborn important German river port export and import trade manufacturing and coal mining pop 410 783 *maps* F 424 *inset* G 88
Dujardin (dü zhar dăN) **Félix** (1801–60) French zoologist born Tours France distinguished protoplasm in 1835 in animal cells calling it 'sarcode' (Natural History of Infusoria)
Dukas (dü kä) **Paul** (1865–1935) French composer professor Paris Conservatory master of orchestration one of leaders of modern French school clever and witty (L'Apprenti Sorcier orchestral work Villanelle for horn and piano Ariane et Barbe Bleue opera based on text by Maeterlinck La Péri dance poem)
Duke James Buchanan (1857–1925) tobacco manufacturer and philanthropist, born near Durham, N C gave millions to charity endowed Duke University N 280
Duke a title of nobility D 40 42
Dukenfield Claude William *See in Index* Fields W C
Duke University at Durham N C for men and women (co ordinate) founded 1924 by expansion of Trinity College (1838) as result of benefactions from James B Duke arts and sciences dietetics, engineering forestry law medicine nursing religion graduate school *picture* N 280
Dukhobors or **Doukhobors** (dŭ kō borz) religious sect founded in Russia middle 18th century emigrated to Canada in large numbers name means spirit wrestlers now call themselves Christians of the Universal Brotherhood
Dulac Edmund (born 1882) English artist born France widely known as illustrator also for portraits and designs for costumes and stage settings books illustrated include The Arabian Nights The Rubaiyat of Omar Khayyam The Sleeping Beauty and Other Tales and Tanglewood Tales
Dulany Daniel (1721–97) lawyer born Annapolis Md R 121–2
Dulcimer (dŭl si mĕr) an ancient musical instrument of Eastern origin forerunner of the piano it consists of a flat sound chamber over which wire strings are stretched and is played by striking the strings with little sticks or cork headed hammers
Dulcinea in Don Quixote *See in Index* Toboso Dulcinea del
Du Lhut (dü lü t) also Duluth **Daniel Greysolon Sieur** (1636–1710) French explorer born St Germain en Laye France set out from Montreal 1678 to explore Lake Superior and westward routes made peace between Chippewa and Sioux Indians in Minnesota built fort on n shore of Lake Superior 1678 rescued Father Hennepin from Sioux 1680 friendliness with Indians made exploration safer and did much to establish French empire in Northwest
Duluth named for D 163
Minnesota expedition M 280
Dulles (dŭl ĕs) **John Foster** (born 1888) lawyer and diplomat born Washington D C grandson of John Watson Foster with law firm of Sullivan and Cromwell New York City 1911–49 acting chairman U S delegation to United Nations General Assembly 1948 interim U S *senator 1949 special* representative of president of U S to negotiate Japanese peace treaty 1950–51 became U S secretary of state 1953 author of War or Peace *pictures* E 287d H 380
Dulong Pierre Louis (1785–1838) French physicist and chemist born Rouen France codiscoverer of Law of Dulong and *Petit on* atomic heats discovered nitrogen trichloride (1811) *See also in Index* Petit Alexis Thérèse
Dulong and Petit Law of in chemistry the law that the atomic heat is about the same for the various elements in solid state
Duluth Minn important shipping center at head of Lake Superior pop 104 511 D 163 *maps* M 288 U 253 *picture* M 290
coal freighter *picture* C 361
Duma (dŏŏ mä) former Russian national assembly F 287–8
Dumas (dü mä) **Alexandre** (1802–70) French dramatist and novelist D 163–4 *picture* F 287
famous *fortress* in Monte Cristo M 102
Dumas Alexandre the Younger (1824–95) French dramatist and social novelist author of Camille D 164 F 288
Dumas Jean Baptiste André (1800–1884) French chemist, born Alais France *noted* for research on atomic weights laws of substitution and theory of types devised a way to determine vapor density
Du Maurier (dü mōr yā) **Daphne** (born 1907) English novelist born London granddaughter of George Du Maurier author of The Du Mauriers Jamaica Inn story of smugglers on Cornish coast Rebecca story of second wife haunted by events in life of predecessor My Cousin Rachel story of a Cornish man and his uncle and their mysterious cousin
Du Maurier George L P B (1834–96) British illustrator and novelist born in Paris France drew gay pictorial satires on society which were chiefly published in *Punch* his novel of the Latin Quarter in Paris Trilby was amazingly successful (other novels Peter Ibbetson The Martian)
Dumbarton Oaks peace conference R 218 W 298
Dum dum India town in West Bengal state 5 mi n e of Calcutta pop 89 434 first produced dumdum bullets
Dumfries (dŭm frēs) Scotland city on river Nith 66 mi s w of Edinburgh pop 26 320 burial place of Robert Burns tweeds hosiery cattle markets *map* B 325
Dummer Jeremiah (1645–1718) silversmith and engraver born Newbury Mass examples of work in colonial silver collections of Metropolitan Museum of Art New York City and Museum of Fine Arts Boston
Dummy in bookmaking B 242
Dumont Gabriel (1838–1906) Canadian rebel born in Assiniboia took part in Northwest rebellion of 1885 as adjutant general of rebel forces escaped to United States
Dumont N J borough 16 mi n e of Jersey City pop 13 013 *map* N 164
Dumont d'Urville (dü mōN dŭr vel) **Jules Sébastien C** (1790–1842) French navigator explored and charted in the South Atlantic South Pacific and Antarctic *table* P 349
Dumouriez (dü mōō ryā) **Charles François** (1739–1823) French general distinguished himself in French Revolution had notable part in victories at Valmy and Jemappes suffered defeat at Neerwinden 1793 then denounced as traitor died an exile in England
Dumping in commerce T 17
Dumyat or **Damietta** (dăm ĭ ĕt ȧ) trade center in Lower Egypt on branch of Nile 100 mi n e of Cairo pop 53 620 ancient city bulwark of Egypt against Crusaders *maps* E 271 A 46
Nile River mouth E 270
Dunajec (dŏŏ nä yĕts) River battle of (1915) W 223 *map* W 222
Dun and Bradstreet a mercantile agency supplying to subscribers reports on the antecedents character capacity capital and credit of business men throughout the world main office New York City established 1841 by Lewis Tappan
Dunant (dü näN) **Jean Henri** (1828–1910) Swiss author and philanthropist founder of Red Cross Society R 87
Düna River Russia *See in Index* Dvina River
Dunbar Paul Laurence (1872–1906) Negro writer best known for poetry much of it in dialect born Dayton Ohio of ex slave parents home in Dayton has been made a public shrine (Lyrics of Lowly Life Lyrics of the Hearthside Complete Poems)
banjo song quoted B 46d
Dunbar William (1460?–1520?) Scottish poet Sir Walter Scott said that he is unrivaled by any which Scotland has produced a disciple of Chaucer but with wider humor and less gentle satire (Two Married Women and the Widow The Dance of the Seven Deadly Sins)
Dunbar Scotland seaport on Firth of Forth 25 mi e of Edinburgh pop 4115 historic old castle Cromwell defeated Scottish Covenanters here (1650) *map* B 324
Dunbarton College of Holy Cross at Washington D C Roman Catholic for women founded 1935 opened 1935 arts and sciences



Our letter E probably started in Egyptian writing as a picture of a man with arms upraised (1) To the Egyptians this picture meant joy or rejoice Soon after 2000 B C a Semitic people called the Semites adopted it as an alphabetic sign for a sound like our h in *hay* They did this undoubtedly because their word for a cry of joy was hallel (as in *hallelujah* joy in the Lord) and the little man made a good sign for the h sound at the beginning of the word

The Semitic letter (2) was like the Egyptian picture but the Canaanites and the Phoenicians simplified this sign to a group of strokes suited to writing from right to left (3) In Hebrew the sign was called *heh* and other Semitic names were similar

When the eastern or Ionic Greeks learned to write from the Phoenicians they did not want a sign for h But they needed a sign for the vowel e and it is easy to see why they thought of using the Semitic sign for h If the forceful h sound is omitted from the beginning of heh the sound eh remains and this is the short sound of the vowel e

The Greeks therefore adopted the *hallel* sign for their short e' They called the letter *epsilon* They also turned it around (4) for greater ease in writing from left to right The Romans adopted this sign for the Latin capital E and from Latin it came to us

The handwriting of Graeco-Roman times changed the letter to a more quickly written form (5) and from this we got our printed and handwritten e'

Note —For the story of how alphabetic writing began and developed *see* the articles Alphabet Writing

TERMS COMMONLY USED IN ECONOMICS AND BUSINESS

Acceptor. One who agrees to pay a check, draft, or other written order.

Accommodation paper. A draft or note given without value received.

Accounts payable. Money due to creditors for which no note, bond, or evidence of indebtedness was given; in bookkeeping, accounts payable appear on credit, or "liabilities," side.

Accounts receivable. Money which is due from customers and other debtors; the opposite of accounts payable.

Accrued dividend. Dividend accumulated, but not paid, since the last dividend payment; preferred stocks are often sold "plus accrued dividend," which means that the accrued dividend is added to the price.

Accrued interest. Amount accumulated on bonds and other evidences of indebtedness, since the preceding interest date; bonds and notes are always sold "plus accrued interest," except when interest is in default, when they are sold "flat" (without interest).

Ad valorem. A tax levied according to value; particularly customs duties, expressed in per cent.

Amortization. The liquidation or reduction of debt through a fixed scale of payments; usually a sinking fund; also the process of writing off each year the premium above par or discount below par, so that the payment at maturity will not show either a loss or profit.

Ancillary receiver. An agent or subordinate receiver, appointed by the court if property is involved in a state other than the one in which the defendant resides or has his principal place of business.

Assumed bonds. Bonds issued by one company, and later assumed or guaranteed by another; assumed bonds rank as a general obligation equally with other bonds of the assuming company. The purchase of equity does not obligate the buyer to assume the bonds.

Audit. Examination of records usually by independent bookkeepers, to show that the accounts are correct.

Balance of trade. Difference between the value of exports and imports.

Bear. One who believes that prices of commodities or securities will go down; he may work to that end either by selling securities he actually owns or by "selling short"; term is supposed to come from the bear's practise of holding down his victim; opposite of "bull."

Bonus. Amount given in addition to regular salary or wages; it may be fixed arbitrarily or in relation to the employer's profits.

Books closed. Time when stock transfer books of a business are closed to permit checking of stockholders to whom dividends are due; a corporation cannot transfer stock from one holder to another while the books are closed.

Book value. The net worth of a business or stock as indicated by the company's books; book value may be either greater or less than par value or market value.

Bucket shop. Popular name for a broker who does not actually buy and sell securities, for which the customer pays, but in effect bets with the customer on the course of future prices; bucket shops are forbidden by law in most states.

Bull. One who buys commodities or securities in expectation that they will advance in price; term is supposed to come from the bull's method of attack, which is to toss upward on his horns; the opposite of "bear."

Carrying charges. Interest charged by brokers for money advanced to carry accounts of their customers for whom they have bought securities on margin.

Closed mortgage. One against which no additional bonds of equal lien can be issued; additional bonds may be issued but they will have only a junior claim to the property.

Commercial agencies. Organizations which obtain the financial standing of individuals and firms and furnish this information to their subscribers.

Commission house. An agency which buys and sells for others on a fee or percentage basis, without assuming any liability for prices.

Convertible bonds. Those which the holder may exchange for some other form of security issued by the borrowing corporation; usually the new security to be received is junior in lien but higher in yield than the original bond.

Corner. The condition of the market when the available supply of a commodity or a security has been concentrated; a corner is the ultimate result of bullish operations.

Coupon. A certificate attached to a bond or mortgage, and specifying the amount of interest payable and the date and place of payment; when interest is due the holder of the bond detaches the coupon and collects the money, usually through a bank which acts as paying agent.

Coupon bond. One to which interest coupons are attached; coupon bonds are payable at maturity to the holder. Ownership at any time passes by delivery from a bona fide holder to a new buyer.

Current assets. Possessions such as cash and inventory, which can be converted into cash without depreciation in value.

Current liabilities. Obligations which are payable in a short time, usually not over twelve months; distinguished from funded obligations or funded debt.

Debenture. An evidence of debt resembling a bond in form but differing from it in its lien; in practise a debenture is a general obligation, merely an unsecured promise to pay, whereas a bond is secured by a mortgage on specified property.

Demurrage. Compensation charged by a railroad or other shipping agency for delay in releasing a freight, a vessel, or other conveyance.

Depreciation. Decrease in the value of assets, due to wear and tear of equipment, to decline in market price, or other causes; depreciation is a loss recognized on the company's books while the assets are still retained.

Due bill. A written acknowledgment of indebtedness; merchandise certificates issued by many stores are forms of due bills.

Earnest money. Part of the purchase price, paid by the buyer to the seller, for the purpose of binding the contract.

Excess profit tax. A federal tax levied against the net incomes of the individuals, partnerships, and corporations in excess of certain exemptions; in the United States the law which was in effect in 1921 used as a basis for this tax the relation between net income and invested capital.

Ex-dividend. Meaning "without dividend." Dividends are declared due to stockholders of record on a specified date. Between the record date and the date on which the dividend is payable, the stock is sold "ex-dividend," the dividend accruing to the seller and not to the buyer.

Fiat money. Paper money which is not based on gold or other specie, but is made legal tender by government order or "fiat"; examples are United States "green back" and French paper money (assignats).

Firm. The term used in grain and stock exchanges to describe binding options granted by a seller to a prospective seller; when a security is offered "firm" the seller obligates himself to deliver the amount specified at the agreed price.

Fiscal year. The twelve months' period for which the accounts of a business or government are figured; in United States the government's fiscal year ends June 30.

Fixed charges. Interest on debt, sinking funds, sometimes rentals and similar items which cannot be reduced, as distinguished from dividends which may be changed by a corporation at its discretion.

F. O. B. (free on board). The price quoted includes all charges up to the time and place of shipment; it does not include freight and delivery charges.

Free trade. The policy of admitting imports without payment of customs duties.

Funding. The conversion of current liabilities into long-term obligations.

Futures. Securities or commodities sold or bought with the assumption of delivery at a later date.

Hedging. A purchase or sale, as an offset to a possible loss; for example, a short sale of wheat by a miller to offset a possible loss in inventory value of flour in storage.

Holding company. A company which owns securities of one or more other companies and is in a position to control or influence the management of these companies.

Interim certificates, or interim receipts. Promises issued by a banker or a trustee to deliver bonds or other securities when they are ready for distribution; they are exchangeable for permanent certificates or bonds without cost to the holder.

Interlocking directorates. When one or more directors are also directors of other corporations the directorates of such corporations are said to be interlocking.

Inventory. A report or statement listing the merchandise on hand and other assets of a business.

Invoice. A statement sent to a purchaser listing the item or items bought and their purchase price.

Joint stock company. A partnership whose funds or capital are divided into shares.

Laissez-faire (Let alone). The doctrine that it is best to let economic forces, particularly competitive effort, work out their results without governmental interference or control.

(Continued on the next page)

TERMS COMMONLY USED IN ECONOMICS AND BUSINESS—*Concluded*

Limited liability company A partnership whose liability is limited to its stated capital distinguished from the ordinary partnership where all the property of the partners may be seized for the debts of the partnership usually indicated by the abbreviation Ltd

Most favored nation. With reference to customs duties special low rates applied to imports from the favored nation usually in return for similar treatment (reciprocity)

Open mortgage Unlimited as to the amount in practice an open mortgage permits the issue of additional bonds or notes provided the total debt and the interest charges continue to maintain a specified ratio to the property value and the net earnings respectively

Option The privilege of buying or selling some specified property or commodity at a given price within a stated time to be legally binding an option must state a consideration

Preference shares or preferred stocks Shares bearing a stated fixed dividend which must be paid out of earnings before common stock dividends are declared ordinarily they are nonvoting shares

Protection The policy of promoting home industry by imposing import taxes on foreign products

Proxy A person who is authorized to act for another also the document conferring this authority

Put and call A special form of option in stock and grain trading the seller of a put has obligated himself to accept within a specified time (usually 30 days) a fixed amount at a stated price the seller of a call on the contrary gives the buyer the right to call on him for delivery of the stock or grain at the price fixed

Pyramiding To buy or sell in business transactions using indicated paper profits as the basis or margin for subsequent transactions

Receiver A person or firm appointed by a court to manage the property or assets of another while adjustment of debt is being made according to statute

Reciprocity A mutual giving and taking particularly the grant of special tariff rates to a country in return for similar favors

Rediscounting The process by which a bank borrows from a central bank or banking system such as the Federal Reserve Banks using as collateral for the loan notes and the obligations which it has discounted for its customers the interest which the central bank charges is called the rediscount rate

Refunding The replacement of an old loan by a new one as a refunding bond

Registered bond One whose ownership is recorded with the corporation issuing it unlike a coupon bond a registered bond is transferable only by endorsement and by subsequent registration on the records

Rent The payment made for the use of property fixed or movable such as real estate or machinery

Reserves Profits set aside in the operation of a business to meet possible future losses or contingent expenses dividends in poor years may be paid out of reserves set aside in earlier good years

Rights The privilege to subscribe usually to stocks and bonds at a price which makes the privilege valuable example a stockholder buys one new share of stock at $100 for each ten shares he already owns the old stock is selling at $?00 the rights will then be worth $?.00 or 1/? of the difference between the market price and the subscription price

Sales tax Tax levied by many state governments on sales of merchandise or commodities usually commodities subject to state excise tax such as gasoline and liquor are exempted

Scalper One who buys and sells for a quick profit often without making a substantial investment

Scrip A certificate issued as evidence of an obligation corporations issue scrip principally in lieu of fractional shares or of cash dividends when they wish to continue dividends while still holding their cash

Secured creditor One who has property pledged to secure the payment of debt

Shareholder or stockholder One who owns shares in a corporation or limited liability company A shareholder is not liable for corporate debt Till the Federal Banking Act of 1935 (effective July 1 1937) national bank stockholders were excepted They were liable for an additional amount equal to par value of their stock this was double liability

Short selling A sale made in anticipation of a decline in price by a seller who does not own the securities or commodities sold The seller (or his broker) may agree to deliver the securities or commodities to the buyer at some future date or may obtain them on credit for immediate delivery In either case he expects to profit by buying the securities or commodities needed to meet his future obligations at a lower price than he received when he made the short sale If he is compelled to buy in at a higher price he is said to be caught short and suffers a corresponding loss

Sinking fund Money set aside out of earnings at stated intervals for the purpose of reducing funded debt

Speculation Trade in securities or other commodities for the purpose of making a profit distinguished from investment which is purchased for the purpose of obtaining income

Surplus The excess of assets over liabilities or the total of profits which has not been distributed or reserved for special needs

Syndicate An association of capital to obtain a definite objective especially a combination of financiers to buy an issue of securities and distribute it by sale to the public

Underwriter One who insures another on life, health or personal property in a policy of insurance

Valorization Maintenance of a commodity's price by governmental control the best example is the Brazilian government's control of the price of coffee

Vital statistics Public records kept by a state city or other governmental subdivision under a statutory provision of births marriages deaths, and disease

Wash sales A fictitious sale correct in form but made without intention to deliver goods in stock market operations wash sales are made by the seller to his agent, or to himself under another name

Wealth Distinguished from riches is anything which has the power to satisfy wants and which cannot be obtained without effort

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Ebers (*ā bĕrs*) **Georg Moritz** (1837–98) German Egyptologist and novelist professor at Jena and Leipzig wrote historical romances with Egyptian settings (An Egyptian Princess Uarda Homo Sum)

Ebert Friedrich (1871–1925) German statesman leader Social Democratic party and first president of the German Republic 1919–25 G 98

Ebony tropical tree E 209
Borneo B 255
resistance to heat F 74

Ebro (*ā brō*) river of n e Spain, flows s e 465 mi from Cantabrian Mts to Mediterranean *maps* S 312, E-425

ECA (Economic Cooperation Administration) U S I 197

Ecbatana (*ĕk băt ạn ạ*) Persia ancient capital of Media summer residence successively of Median Persian and Parthian kings by whom it was captured and pillaged in turn archaeological excavations modern Hamadan Iran *maps* P 156 I 224

Ecce Homo (*ĕk sĕ hō mō*) Latin for behold the man words of Pilate in showing Christ to the people (John xix 5)

Eccentric (*ĕk sĕn trĭk*) of steam engine *diagrams* S 388 389 390

Eccentricity (*ĕk sĕn trĭs ĭ tĭ*) in astronomy measure of elongation of an ellipse the ratio of the distance between foci to major axis
planets P 285

Ecclefechan (*ĕk l fĕк ạn*) village in Scotland 14 mi e of Dumfries birthplace of Thomas Carlyle

Eccles England city on Manchester Ship Canal, 4 mi w of Manchester of which it is suburb cotton fabrics engine works famous for Eccles cakes pop 43 927 *map* B 324

Ecclesia Athenian assembly D 63

Ecclesiastes (*ĕ klē zĭ ăs tēz*) (the preacher) a book of the Old Testament attributed by Jewish tradition to Solomon
quotation from B 231

Ecclesiasticus one of the disputed books of the Old Testament B 136

Ecgbert *See* 11 *Index* Egbert

Echegaray (*ā chā gä rä ē*) **José** (1833–1916) Spanish mathematician statesman and dramatist shared Nobel prize in literature with Frédéric Mistral in 1904 (Mariana The Great Galeoto The Son of Don Juan The World and His Wife) S 376

Echelon (*esh e l n*) in aviation formation in which planes fly such as a V formation *See also* 11 *Index* Aviation *table* of terms

Echeveria (*ĕk ĕ vē rĭ ạ*) a genus of perennial plants of the orpine family native chiefly to Mexico The fleshy often hairy many-colored leaves are covered by white powdery material used as foliage plants

Echidna (*ē kĭd nạ*) or spiny ant eater Australian mammal related to the duckbill D 183 *picture* A 480

Echinacea (*ĕk-ĭ-nā sē ạ*) a genus of perennial plants of composite family similar to the rudbeckias Tall leaves rough flowers daisylike pink rose purple also called purple coneflower native to North America roots source of an oleoresin

Echinodermata or echinoderms (*ē kī nō dērmz*) a phylum of marine in

ü=French u German ü *g*em *g*o *th*in *th*en *n*=French nasal (Jean) *zh*=French *j* (z in azure) *K*=German guttural *ch*

products fish U S Coast Guard shipyard air base Elizabeth City State Teachers College *map* N 275

Elizabethton Tenn city on Watauga and Doe rivers 10 mi n e of Knoxville pop 10 754 rayon furniture twine hosiery flour lumber iron *bauxite and manganese mines map* T 67

Elizabethtown College at Elizabethtown Pa founded by Church of the Brethren 1899 opened 1900 arts and sciences business education

Elisabethville Belgian Congo *See in Index* Elisabethville

Elizabeth Woodville (1437?–92) queen of Edward IV of England mother of Edward V and Elizabeth queen of Henry VII R 151 1 265

Elk name given in America to the wapiti and in Europe to the moose E 334b–5 *picture* E 335
European elk M 391
Irish elk M 391
wapiti W 7

Elkhart Ind manufacturing and rail road city in n central on St Joseph and Elkhart rivers pop 35 646 has largest band instrument factory in world *maps* I 78 U 253

Elk Hills Calif naval oil reserve H 268

Elkhorn coral *picture* C 478

Elkhound Norwegian *table* D 118a

Elk Island National Wild Animal Park in Alberta, Canada N 38*f* *maps* N 38*f*, C 80–1

Elk Mountains range in w Colorado just w of Sawatch Range

Elko Nev city in n e on Humboldt River about 90 mi from Utah border pop 5393 cattle and sheep *maps* N 132 U 252

Elks Benevolent and Protective Order of a fraternal society organized in New York City in 1868 from an older society known as the Jolly Corks and now having branches in practically all large cities of U S and its dependencies In addition *to assistance to members the order* is known for ready response to calls for aid from the outside

Ell obsolete measure of length varies from 27 to 48 inches in different countries English ell 1¼ yards

Ellery William (1727–1820) signer of Declaration of Independence born Newport R I member of Continental Congress 1776–81 1783–85 state chief justice (1785)
signature reproduced D 37

Ellesmere (*ĕl mer*) **Island** Canada n w of Greenland from which it is separated by Smith Sound and Kennedy Channel 75 000 sq mi uninhabited barren waste almost *covered by glacial ice caps map* N 250
size comparative *See in Index* Islands *table*

Ellice (*ĕl is*) **Islands** group of small coral islands in Pacific n of Fiji Islands 14 sq mi pop 4487 under British protection since 1892 included in Gilbert and Ellice Islands Colony since 1915 *map* P 16–17
people P 4

Ellington Edward Kennedy (Duke) (born 1899) Negro pianist conductor composer singer born Washington D C won fame as band leader master of swing music appeared on stage in Porgy and Bess (Mood Indigo Solitude Sophisticated Lady)

Elliotson John (1791–1868) English physician one of the first to urge clinical lectures as method of teaching medicine physician to both Dickens and Thackeray lenden his dedicated to him

Elliott Maxine (1873 1940) actress and noted beauty born Rockland Me managed for a time by Augustin Daly star in Twelfth Night Midsummer Night s Dream and other Shakespearean plays

Ellipse a closed curve generated from two points called foci the sum of the distances from any point on the curve to each of the foci is always the same for any given ellipse It can be drawn by placing a loop of string loosely over two pins stuck in a drawing board and passing a pencil around inside the loop the character of the ellipse will be determined by the length of the loop and the distance between the pins
earth s orbit F 191–2

Ellipsoid (*ĕ lip soid*) in geometry *diagram* G 61

Ellis Henry (1721–1806) English *hydrographer* and colonial official elected fellow of Royal Society for book about voyage to Hudson Bay in search of northwest passage as governor of Georgia (1758 60) provided for guarantee of titles to land protected coast during French and Indian War

Ellis (Henry) Havelock (1859 1939) English *psychologist and philosopher* trained physician gave up practice to study and write on psychology especially problems of sex (Studies in Psychology of Sex The Soul of Spain The World of Dreams The Dance of Life)

Ellis Island island in Upper New York Bay U S immigrant and deportation station *189 –1954* I 48 N 216 *map* N 222 *pictures* I 48 N 218

Ellison Ralph (born 1914) Negro writer born Oklahoma City Okla (Invisible Man powerful novel depicting the status of the Negro)

Ellora (*ĕ lo ra*) town in Hyderabad *state* India
famous temples H 432

Ellsworth Elmer Ephraim (1837–61) American soldier colonel of Ellsworth s Zouaves born near Saratoga Springs N Y shot at Alexandria Va regarded in his day as first martyr to Union cause

Ellsworth Lincoln (1880–1951) explorer born *Chicago Ill* with Amundsen in Arctic flights 1925 1926 in 193 raised U S flag over 300 000 sq mi of unclaimed land in Antarctica explorations in interior of Antarctica 1935 1938 1939 (My Four Antarctic Explorations a magazine article Exploring To day a book) P 351 352 A 261 *map* P 346 *table* P 343

Ellsworth Oliver (1745–180) statesman and jurist born Windsor Conn U S senator from Connecticut 1789 96 drafted bill organizing federal courts introduced Connecticut Compromise chief justice of U S Supreme Court 1796–99

Ellsworth Highland in Antarctica region extending s w from base of Palmer Peninsula discovered 1935 by Lincoln Ellsworth A 261 *map* A 259

Ellwood City Pa borough 34 mi n w of Pittsburgh in center of coal iron and limestone district pop 12 945 foundry and machine shops forging works *nails wire map* P 132

Elm tree E 335–6 *pictures* T 181–2
Chinese for windbreaks A 66
engraver beetle *picture* I 162
leaf *pict re* T 183
Penn s treaty P 121
thuk E 335
Washington elm C 50
wood F 336 *table* W 186c

Elman Mischa (born 1891) Russian violinist made debut at age of 13 won international fame became resident of U S 1923

Elmendorf Theresa Hubbell West (1855–1932) librarian born Pardeeville Wis became deputy librarian 1880 and librarian 1892–96 Milwaukee Wis Public Library first woman president American Library Association 1911–12

Elm family or **Ulmaceae** (*ŭl mā se ē*) a family of shrubs and trees including the American elm hackberry sugarberry English elm Chinese elm slippery elm sawleaf zelkova and the water elm

Elmhurst Ill city about 15 mi w of Chicago chiefly residential pop 21 273 stone quarries brick green houses Elmhurst College *map* inset I 38

Elmhurst College at Elmhurst Ill founded 1871 by Evangelical and Reformed church arts and sciences

Elmira N Y manufacturing city on Chemung River mi n of Pa boundary pop 49 716 business machines metal products glass products fire fighting equipment electronic tubes Elmira College *maps* N 204 U 253

Elmira College at Elmira N Y for women chartered 1855 as the first college for women in the United States arts and sciences nursing and teacher education secretarial studies

Elm leaf beetle a coleopterous insect (*Galerucella luteola*) accidentally introduced into the U S larvae feed on lower side of elm leaves gradually skeletonizing the leaf

El Morro (The Castle) **National Monument** also **Inscription Rock** w central New Mexico 4 mi s e of Gallup N 181 N 33 *map* N 18

Elmo s fire Saint L 241

Elmwood Park Ill residential suburb of Chicago pop 18 801 *map inset* I 38

Eloh m (*ĕ lo h m*) name for God used in some Hebrew Scriptures

Elon College at Elon College N C affiliated with Congregational Christian church chartered 1889 opened 1890 arts and sciences

Elongation of a planet in astronomy the angular distance between a planet and the sun as seen from the earth

El Palmito Dam (Lázar Cardenas) in Mexico on Nazas River *See also in Index* Dam *table*

El Pao formerly El Florero mountain in n e Venezuela iron ore discovered 1926 by native prospector mining operations began 1950 by an American mining company V 442

El Paso (*ĕl pă so*) Tex main distributing point for s w U S and main gateway between U S and Mexico pop 130 485 E 336 T 82 94 *maps* U 252, *inset* T 91
irrigation of cotton nearby *picture* C 493
Sun Bowl F 230

El Qahira Egypt *See in Index* Cairo

El Qantara, Egypt *See in Index* Qantara, El

El Reno Okla city 25 mi w of Oklahoma City pop 10 991 railroad shops flour dairy and foundry products Fort Reno U S Army fort nearby *map* O 370

El Rito (*ĕl rē tō*) N M, village in n Spanish American Normal School *map* N 178

private land is often condemned for the building of railroads canals etc and the owner paid a just compensation
Emin Pasha (*ĕm in pä shä*) (1840–92) Turkish name of Eduard Schnitzer German explorer and administrator in Africa
Stanley rescues S 369
Emir *See in Index* Amir
Emission spectrum of light S 331
Emma (1858–1934) queen of William III of the Netherlands mother of Queen Wilhelmina regent 1890–98
Emmanuel *See in Index* Immanuel
Emmanuel College at Boston Mass Roman Catholic for women founded 1919 arts and sciences
Emmanuel Missionary College at Berrien Springs Mich Seventh-day Adventist founded 1874 liberal arts
Emmenthal (*ĕm ĕn täl*) fertile valley in canton of Bern Switzerland 25 mi long 11 mi wide gives name to Emmenthaler (Swiss) cheese
Emmer (*ĕm ẽr*) a primitive type of wheat W 118 119 *picture* W 116
Emmet Robert (1778–1803) Irish rebel led unsuccessful revolt against Dublin Castle escaped but returned to his betrothed Sarah Curran was caught and hanged
Emmett Daniel Decatur (1815–1904) actor and song writer born Mount Vernon Ohio composed Old Dan Tucker at age of 16 originator of Negro minstrel performances composed Dixie
Emmons Mount in the Uinta Range Utah 13,498 ft *map* U 418
"Emmy" statuette presented annually by Academy of Television Arts and Sciences Hollywood Calif designed and sculptured by Louis McManus first awarded 1949 name suggested by Harry R Lubcke Academy president 1949 from "Immy" engineering term referring to Image Orthicon camera *See also in Index* Academy of Television Arts and Sciences
Emory and Henry College at Emory Va Methodist founded 1836 opened 1838 arts and sciences
Emory University near Atlanta Ga Methodist founded 1836 arts and sciences business administration dentistry law medicine nursing theology graduate school
Emotion E 340–340b *pictures* E 340–340b
adolescence A 22–22a *pictures* E 340 340a
aroused by odors S 200
arts and the emotions A 400c–e
child development and training C 240c–d 245a b E 340–340b *pictures* C 242 245b–8 E 340–340b
colors affect C 400
feelings S 99
hypothalamus and E 340b B 280
insomnia emotional conflicts cause S 199
mature and immature expressions M 142j–k
polygraph measures and records reactions *picture* P 427
smells related to S 200
training for maturity C 245–8
Empedocles (*ĕm pĕd ŏ klēz*) (490?–430 B C) great Greek philosopher poet statesman superhuman character in legend said to have cast self into crater of Mt. Etna (Matthew Arnold's Empedocles on Etna)
theory of elements P 232
Empennage (*äṅ pe näzh*) of airplane A 89
Emperor title of head of an empire Latin *imperator* first used by Julius Caesar in 58 B C from *imperium* power of a general to enforce his commands
Emperor penguin P 120
Empire Holy Roman H 408 9 *See also in Index* Holy Roman Empire
Empire Day or **Victoria Day** a holiday May 24 (the birthday of Queen Victoria) in British Empire originated 1897 by Mrs Clementina Fessenden of Hamilton Ontario Canada to stimulate patriotism F 58
Empire State popular name for New York
Empire State Building *picture* N 217
compared with a modern ocean liner *picture* S 157
site in the 1880's *picture* A 392
Empire State of the South name sometimes given to Georgia G 69
Empire style
decoration I 179 *table* I 178
dress D 150
Empirical medicine M 164
Empiricists in philosophy P 203
Employees Compensation Bureau of and **Employees Compensation Appeals Board** U S U 367
Employers liability F 311 I 169
Employment *See also in Index* Labor Unemployment
advertising industry A 26–7
changes in U S 1890 1950 *pictograph* L 315
full employment L 70 70a
leisure time activities L-159 61
men and women percentages *chart* U 316
nonworkers percentages *chart* U 316
old age problem P 372 3
20th-century shifts *chart* U 316
women workers increase in *chart* U 316
Employment Security Bureau of U S U 367
Employment Service United States U 367
Emporia Kan city 53 mi s w of Topeka pop 15,669 home of *Emporia Gazette* William Allen White editor 1895 1944 Kansas State Teachers College and College of Emporia *maps* K 11 U 253
Emporia College of at Emporia Kan Presbyterian founded 1882 liberal arts
Empress Eugénie famous diamond *picture* D 79
Ems (*ĕms*) also **Bad Ems** Germany a health resort on Lahn River 10 mi e of Coblenz from here was sent famous Ems dispatch
Ems dispatch B 198 F 277
Ems River in n w Germany flows n w 200 mi to North Sea irrigates surrounding country through canals *map* G 88
Emu (*ē mū*) large Australian running bird D 341 *picture* E 341
egg *picture* E 269
related to ostrich O 427
speed B 166
Emulsion a liquid mixture in which a substance is suspended in minute globules
colloidal in nature C 384 385
photographic P 221 224
soap S 211
Emulsoid a colloid mixture of liquids C 385
En a type measure T 229
Enamel a paint P 41
lacquer enamel L 82
Enamel of teeth T 35 *picture* T 36
Enameling coating metal glass or pottery with a glassy composition E 341 3 *pictures* E 342–3
champlevé E 341 2
Chinese *picture* E 342
cloisonné E 341 *pictures* E 342 3
coloring enamel E 342 G 134
Hindu I 66
ironware E 342
Japanese E 341 *pictures* E 343 J 319
molybdenum used M 335
niello or black work E 386
watch dials W 56
Enargite a blackish copper ore copper sulfarsenate (Cu_3AsS_4)
Encarnación (*en kar na sjŏn*) Paraguay city in s e on Paraná River pop 17,779 *map* S 253
Encaustic painting a method in which wax is combined with the colors after the mixture has been applied it is made permanent by being fused with a hot iron
Encaustic tile B 305
Encephalitis (*ĕn sef ä lī tis*) a form of sleeping sickness *See also in Index* Sleeping sickness
Encephalogram (*ĕn-sef ä lō grăm*) B 283
Encephalograph B 283
Enchanted Mesa a superb mesa in w central New Mexico near Acoma Pueblo 55 mi s w of Albuquerque called Katzimo (the Accursed) by Acoma Indians according to tradition their ancestors who had gone to their fields in the plains were prevented from returning to their high mesa home by a terrific storm which destroyed the rock ladder leaving 3 women above 2 to die of starvation and 1 to commit suicide
Encke (*ĕng kĕ*) **Johann F** (1791–1865) German astronomer born Hamburg determined orbit and period of recurrence (every 3.3 years) of comet discovered by Pons 1818 since called Encke's comet measured distance between sun and earth
Encomienda (*en kō mi ĕn dä*) (Spanish meaning "to entrust") estate of land including inhabitants granted to early colonists in South America by Spanish crown M 200 S 276
Encyclical a papal letter concerning church welfare addressed to all archbishops and bishops differs in form from a bull
papal bull P 66
Encyclopaedia Britannica R 88e
Encyclopedia from ancient Greek word meaning whole circle of knowledge P 88c–e
how to use Compton's Pictured Encyclopedia *See* Publishers Foreword at beginning of Vol A *see also* Editor's Note at beginning of each Fact Index section
selected list R 88e
Encyclopedists writers of great French encyclopedia including Diderot and other distinguished thinkers of 18th century
influence F 292
Enderbury Island one of Phoenix Islands s Pacific *See in Index* Phoenix Islands
Enderby Land region in Antarctica between Ice Bay and Edward VIII Bay discovered 1831 by John Biscoe an Englishman *maps* A 238 A 259 W 205
Enders John Franklin (born 1897) bacteriologist born West Hartford Conn on faculty Harvard University medical school 1929 with T H Weller and F C Robbins won 1954 Nobel prize in medicine and physiology for work on growth of polio virus for vaccine
Endicott or **Endecott John** (1588?–1665) leader of Puritan band which settled (1628) at Naumkeag now Salem Mass born England governor of Massachusetts Bay Colony for many years capable and zealous

KINGS AND QUEENS OF ENGLAND

SAXON

802–839	Egbert
839–858	Ethelwulf
858–860	Ethelbald
860–865	Ethelbert
865–871	Ethelred
871–899	Alfred the Great
901–924	Edward the Elder
924–939	Athelstan
939–946	Edmund I
946–955	Edred
955–959	Edwy
959–975	Edgar
975–978	Edward the Martyr
978–1016	Ethelred the Unready
1016	Edmund II Ironside

DANISH

1016–1035	Canute (Cnut)
1035–1040	Harold I
1040–1042	Harthacanute

SAXON

1042–1066	Edward the Confessor
1066	Harold II

NORMAN

1066–1087	William I the Conqueror
1087–1100	William II
1100–1135	Henry I
1135–1154	Stephen

PLANTAGENET

1154–1189	Henry II
1189–1199	Richard I
1199–1216	John
1216–1272	Henry III
1272–1307	Edward I
1307–1327	Edward II
1327–1377	Edward III
1377–1399	Richard II

LANCASTER

1399–1413	Henry IV
1413–1422	Henry V
1422–1461	Henry VI

YORK

1461–1483	Edward IV
1483	Edward V
1483–1485	Richard III

TUDOR

1485–1509	Henry VII
1509–1547	Henry VIII
1547–1553	Edward VI
1553–1558	Mary I
1558–1603	Elizabeth I

STUART

1603–1625	James I
1625–1649	Charles I
(1649–1660	Commonwealth)
1660–1685	Charles II
1685–1688	James II
1689–1702	William III and Mary II (until her death in 1694)
1702–1714	Anne

HANOVER

1714–1727	George I
1727–1760	George II
1760–1820	George III
1820–1830	George IV
1830–1837	William IV
1837–1901	Victoria

SAXE COBURG GOTHA (WINDSOR)

1901–1910	Edward VII
1910–1936	George V
1936	Edward VIII
1936–1952	George VI
1952	Elizabeth II

ü=French u German ü gem go thin then n=French nasal (Jean) zh=French j (z in azure) K=German guttural ch

Escalator clause in union contract I 145 L 75
Excalibur or **Excalibur** King Arthur's sword A 393
Escanaba Mich city on inlet of Green Bay pop 15 170 lumber veneers paper chemicals iron sum mer resort good harbor *map* M 226
Escanaba River Mich rises in n w part of upper peninsula and flows s e about 100 mi emptying into Green Bay at Escanaba Mich *maps* M 219 226
Escapement in clocks and watches W 55
chronometric W 57
gravity W 56
Escape velocity, or parabolic velocity S 309*a*
Escarpment in geology steep face of cliff usually caused by erosion or by prehistoric changes in the water line
Niagara *picture map* N 231
Escaut *See in Index* Schelt
Eschenbach Wolfram von *See in Index* Wolfram von Eschenbach
Eschscholtzia (*ĕ shŏlt si a*) califor nia the California poppy P 370
how to plant *table* G 16
Escorial, near Madrid Spain M 28
pictures M 27
library *picture* S 322
Escrow in law *See in Index* Law *table* of legal terms
Escudo (*ĕs kū dō*) a gold Portuguese monetary unit his orical value about $1 08
Esculapius *See in Index* Aesculapius
Escutcheon in heraldry H 341
Escutcheon pin *picture* N 1
Esdraelon (*ĕs drĕ l n*) Plain of also Emek Israel the greatest plain of Palestine fertile level roughly triangular bounded by Mt Carmel on w Mt Gilboa on s e highlands of Galilee on n battlefield in all ages P 44 *map* P 45 *picture* P 43
Esh Sham Syria *See in Index* Damascus
Esker glacial mound I 4
Eskimo curlew S 209
Eskimo dog D 110 *picture* D 110*a*, *table* D 118*a*
Eskimos Indians that live in the Arctic regions F 393–7 I 94 *map* I 106*f* *pictures* E 393–7 P 350*a*–1 *table* I 107
Alaska A 133
boats C 114 E 395 *pictures* B 218 E 398 G 214
bow drill for fire *picture* F 73
children E 396 *pictures* E 393 395, 397 P 142*a*
clothing E 393–4 395 *pictures* C 354 P 142*a* L 393 7 F 321 D 110*a*
sealskin boot or kamik *picture* S 162
culture area *map* I 91
dog Eskimo E 394 D 110 *picture* D 110*a* *table* D 118*a*
dolls D 122
food and cooking E 394 395
Greenland G 213–14 E 397
history early E 396
how the people live E 393–5 396
hunting customs E 394–5 *pictures* E 394 396 G 214 S 88
influence of the white man E 397
lamps and lighting I 88 F 394
language and writing F 396
racial classification E 396 *chart* R 22
reindeer R 97 *picture* E 394
religion E 396
rules of conduct E 404
seal hunting E 394–5 S 88 90 *pictures* F 394 G 214 S 88
shelter E 394 S 210 *pictures* E 393 S 144*b* P 350*a*
Esmeralda in Victor Hugo's Notre Dame de Paris a beautiful street dancer of Paris (supposedly a gypsy) who is accused of witchcraft is hidden from her accusers in the belfry of Notre Dame Cathedral by the hunchback bell ringer Quasimodo but is finally executed
Esna Egypt *See in Index* Isna
Esophagus (*ē sŏf a gus*) oesophagus or gullet muscular tube from mouth to stomach S 400 401 P 244 D 91*a* *color pictures* P 242 3 *diagram* D 91
pouter pigeons P 254
Española or **Hispaniola** name given by Columbus to Haiti H 245
Espartero (*ĕs pär tā rō*) **Baldomero** (1792–1879) Spanish soldier and statesman conspicuous for successes against Carlists in 1836 40 then for three years regent for Isabella child queen retired from public life 1856 modest man of strongly liberal tendencies
Esparto grass or alfa plant a fibrous grass native to n Africa and s Spain used for mats baskets rope sandals and in papermaking
Espejo (*ĕs pā hō*) **Antonio de** 16th century Spanish merchant explorer his journeys in n Arizona (1582) and discovery of rich mines while searching for a lake of gold spurred prospectors and inspired Oñate's trip 20 years later
Esperanto (*ĕs pa ran tō*) an international language E 397
Esperey Franchet d Louis *See in Index* Franchet d Esperey
Espina de Serna (*ĕs p na dĕ sĕr nä*) **Concha** (1877 19 5) Spanish novelist known for her clear style and sympathetic portrayal of characters ('Mariflor' 'Altar Mayor' 'The Woman and the Sea')
Espionage practice of spying war international law concerning I 190
Espionage Act 1917 U S A 167
Espirito Santo (*ĕs pe rē tu sa tu*) small state of Brazil on s e coast 17 252 sq mi pop 870 987 cap Victoria B 291–2
Espy (*ĕs pĭ*) **James Pollard** (1785 1860) meteorologist born Westmoreland County Pa instituted telegraphic weather bulletins appointed meteorologist to U S War Department 1842 later to Navy Department laid foundation of present United States weather bureau published Philosophy of Storms
Esquiline (*ĕs kwi lin*) **Hill** highest of the seven hills of Rome P 194
Esquimalt British Columbia seaport and naval station on Vancouver Island about 2 mi w of Victoria has large harbor naval yards and fortifications industries include shipbuilding and salmon canning
Esquimaux *See in Index* Eskimos
Esquire courtesy title given a gentleman D 42
Esquire or **squire** knight's attendant K 55 6
Essad (*ĕs sad*) **Pasha** (1875?–1920) Turkish soldier bandit and provisional president of Albania (1914) killed in Paris
Essay a form of writing E 397–8 L 98*c*
American A 226*a* *c* *d* *e* E 398
English E 379 382
early writers Addison and Steele E 378 E 398 A 18 Francis Bacon B 11 E 398 E 377
how to write W 314
Montaigne father of M 366 F 397
Essay on Criticism poem by Pope P 369
Essay on Man poem by Pope P 369
Essays of Elia by Lamb L 88
Essen (*ĕs ĕn*) Germany industrial and railroad center in Ruhr River valley pop 605 411 E 398 *maps* E 416 424 *inset* G 88
Essential oils volatile odoriferous oils F 45
in perfumes P 147–8
in spices S 340
in wintergreen W 156
Essequibo (*ĕs e kē bō*) largest river of British Guiana South America 600 mi long flows into Atlantic by estuary 20 mi wide *maps* G 223 S 252 256
Essex Robert Devereux 2d earl of (1566? 1601) English soldier and courtier favorite of Queen Elizabeth I won distinction in war with Spain later fell into disfavor tried to excite insurrection was executed for treason E 333
Essex Robert Devereux 3d earl of (1591–1646) English general son of preceding commander of Parliamentary forces 1642–45 in Civil War
Essex ancient kingdom of the East Saxons in England conquered by Egbert king of Wessex and became part of Wessex *map* E 358
Essex maritime county in s e England 1531 sq mi pop 2 043 574 cap Chelmsford included in kingdom of East Saxons grazing wheat and barley extensive manufactures *map* E 347
Essex U S frigate F 37
Essex Junto group of Federalist leaders including Timothy Pickering Fisher Ames George Cabot and some of the Lowell family living in Essex County Mass accused by John Adams whose policies they disapproved of being a British faction opposed war with England in 1812
Essling prince of *See in Index* Masséna André
Essling village in Austria 7 mi e of Vienna between it and Aspern occurred bloody battle between French and Austrians 1809
Established church in England *See in Index* England Church of
Estaing (*ĕs tăn*) **Charles Hector comte d** (1729 94) French admiral served first in army later in navy aided U S against England in Revolutionary War active in French Revolution because of sympathy with Marie Antoinette was condemned and executed
Estancia (*ĕs tän sya*) Spanish American term for a cattle ranch S 264
Argentina A 331
Chile C 253
Estate in law a person's entire property more particularly property left at death an estate is said to be closed when the decedent's will has been carried out or when if no will was left the estate has been divided in accordance with state laws
trust companies administer T 202
Estates General former representative assembly of France E 398 9
meeting in 1789 F 292
Mirabeau M 293
Robespierre R 163
Talleyrand T 8
Estate tax T 24*a* *b*
Este (*ĕs tä*) **House of** old and illustrious family of Italy capital at Ferrara famous for political importance and splendid court encouraged poets painters and scholars **Alberto Azzo II** (11th century) was common ancestor both of House of Este and of House of Guelf to which the British royal House of Hanover belonged Al-

fonso of Este (1476–1534), duke of Ferrara, husband of Lucretia Borgia, was patron of Tasso.

Ester, one of a large group of liquid and solid compounds formed by reaction of an acid and an alcohol with elimination of water; for example, acetic acid (CH_3COOH) plus methyl alcohol (CH_3OH) gives the ester, methyl acetate ($CH_3CO_2CH_3$) plus water (H_2O). Most oils, fats, and waxes are esters; so are many plastics, such as cellulose acetate: O-424c
 formula, *diagram* O-424b

Ester Abad, Iran. *See in Index* Asterabad

Ester gums P-41

Esterházy (*ĕst'ĕr-hä-zē*), a noble Hungarian family of ancient origin, members of which have held prominent places in Hungarian history down to recent times. **Prince Nicholas Esterházy** (1765–1833), patron of the arts, friend of Haydn, refused Napoleon's offer of crown of Hungary
 Liszt and L-266

Estes, Eleanor (born 1906), writer of children's books, born West Haven Conn.; became children's librarian at the New Haven Free Library and later at the New York Public Library. Her books for children: 'The Moffats' (with a setting similar to the author's birthplace); 'The Middle Moffat'; 'Rufus M'; 'The Hundred Dresses'; 'Ginger Pye', winner of Newbery medal 1952.

Estes Park, in Colorado N-38b, *maps* C-402, 409

Esther (*ĕs'tĕr*), heroine of the Old Testament book of this name E-399–400

Esthetics, or **aesthetics** (*ĕs-thĕt'iks*), branch of philosophy that deals with the beautiful P-204

Esthonia. *See in Index* Estonia

Estienne (*ā-tē-yĕn'*), or **Etienne** (in Latin **Stephanus**), **Henri** (died 1520), French printer, founder of the family which was supreme in printing for three generations; after his death his foreman, Simon de Colines, married his widow and continued the business.

Estienne, Henri (1531–98), French author, editor, and printer, son of Robert; compiled great Greek thesaurus, still used; wrote 'An Apology for Herodotus', bitter satire on contemporary life; his writings important in standardizing literary French.

Estienne, Robert (1503–59), French printer and scholar, son of the first Henri; noted for editions of Greek classics, and for magnificent Greek New Testaments (1546 in 16mo, 1550 in folio) which remained the accepted text for three centuries.

Estigarribia (*ĕs-tē-găr-rē'byä*), **José Félix** (1888–1940), general and statesman, born Caraguatay, Paraguay; leader and hero of the Chaco War; minister to U. S. 1938–39; president of Paraguay 1939–40; self-proclaimed dictator 1940; killed in airplane crash.

Estilo (*ĕs-tē'lō*), type of ballad sung by gauchos L-116

Estivation, or **aestivation**, summer sleep of certain animals, in contrast to hibernation or winter sleep H-353
 fish F-107
 insects I-159–60
 snails and slugs S-204

Estonia (*ĕs-tō'ni-a*) (**Estonian Soviet Socialist Republic**), formerly Esthonia, Russia, on Baltic Sea; area 17,400 sq. mi.; pop. 1,000,000; cap. Tallinn: E-400, *maps* R-260, 266, E-417
 "White" movement (1919) W-241

Estonian language E-400

Estremadura (*ĕs-trĕ-ma-dur'a*), province of Portugal, in which Lisbon lies; 2062 sq. mi., pop. 1,595,067: P-378

Estremadura, region in w.-central Spain, about 16,000 sq. mi.; chief occupations agriculture (livestock, olives, grapes, wheat, barley) and mining (phosphate, lead, iron, zinc, tin, copper)
 Civil War militia, *picture* S-322b
 ruins of Roman theater, *picture* S-322

Estron, a type of rayon R-81

Es'tuary, the widened mouth of a river where it joins the sea; may be caused by the current of the stream and tidal action or may be a submerged section of a river valley R-156

Etah, Eskimo settlement on n.w. coast of Greenland known as base for Arctic expeditions *map* N-250

Etching E-385–8, *pictures* E-385–8. *See also in Index* Engraving and etching

Eternal City (Rome), why so called R-189

Eternal Light, peace memorial G-106

Ete'sian wind W-150

Ethane (*ĕth'ān*), a colorless and odorless gaseous compound of hydrogen and carbon (C_2H_6) forms ethyl radical in chemical combinations. *See also in Index* Paraffin series
 formula *diagram* O-424a

'Ethan Frome', novel by Edith Wharton A-230b

Eth'elbald, or **Aethelbald**, king of Wessex 858–860

Ethelbert, or **Aethelberht**, king of Kent 560–616, bretwalda or overlord over all the English s. of the Humber, and author of the first written English laws
 St. Augustine converts C-114

Etheldreda (**Aethelthryth**), or **Awdrey, Saint**, daughter of king of East Anglia and wife of king of Northumbria; founded religious house at Ely, A.D. 673; her festival became occasion for annual large fair at which cheap, trifling objects were sold, whence came the word "tawdry," a contraction of St. Awdrey; festival in Latin church, June 23, Anglican October 17.

Ethelfleda (*ĕth-ĕl-flā'dä*), or **Aethelflaed** (died A.D. 917?), eldest daughter of Alfred the Great, wife of the earl of Mercia.

Ethelred, or **Aethelred**, king of Wessex and Kent 865–871, brother of Alfred the Great A-152

Ethelred, or **Aethelred**, the **Unready**, king of the English 978–1016; his marriage with Norman princess Emma opened distinct policy which led to the Norman conquest of England: E-359, E-264

Ethelwulf, or **Aethelwulf**, king of Wessex 839–858, father of Alfred the Great.

Ether, in alchemy A-145

Ether, in chemistry, the type of compound in which two organic radicals are united by an oxygen atom; formed by the union of two molecules of an alcohol with elimination of water: E-400, O-424c
 ancient "element" A-145
 anesthetic A-246: discovery L-307; overdose, treatment for F-96
 formula, *diagram* O-424b

Ether, in physics E-400, L-232
 drift experiment M-215, R-98, 99

Etherege (*ĕth'ĕr-ĭj*), **Sir George** (1635?–91), English dramatist, first important figure in Restoration comedy; originated comedy of intrigue ('The Comical Revenge; or, Love in a Tub'; 'She Wou'd, if She Cou'd'; 'The Man of Mode; or, Sir Fopling Flutter').

Ethical culture, a movement inaugurated by the founding of New York Society for Ethical Culture by Felix Adler in 1876; two federations have been formed, the American Ethical Union, organized in 1886, composed of ethical societies in seven American cities, and the International Ethical Union, organized in 1896. Affirming the supremacy of moral law and seeking social reforms, the societies have pioneered in progressive education, settlement work, housing, etc.

Ethics E-400, P-203
 Christianity, effects of C-304
 Marcus Aurelius' 'Meditations' M-94
 mature attitudes M-142l
 sociology, relation to S-221
 sportsmanship *See in Index* Sportsmanship

Ethiopia (*ē-thi-ō'pi-a*), country occupying most of n.e. projection of Africa, also known as Abyssinia; 350,000 sq. mi.; pop. 10,079,200; cap. Addis Ababa: E-401–3, *maps* E-402, A-46, *pictures* E-401–3
 Abyssinia, origin of name A-4
 agriculture E-401, 402
 animals: baboon, *picture* M-351; sheep, *picture* S-136
 children, *picture* E-401
 cities E-403
 climate E-401
 clothing, *pictures* E-401, 402, 403
 commerce E-403
 communication E-402–3
 education E-403, *pictures* E-401, 403
 flag F-136d, *color picture* F-134
 government E-401
 history E-403
 minerals E-403
 natural features E-401, 403
 people E-402, *pictures* E-401, 402, 403: how the people live E-402
 products E-403: coffee C-376, 380
 relationships in continent, *maps* A-46–7, 41–2, 39, 51
 religion E-402, A-49: converted to Christianity E-403
 rivers E-403
 shelter E-402, *picture* E-402
 transportation E-402–3

Ethiopian region, one of the six great zoogeographical divisions of the world Z-361

Ethiopic language H-326

Ethmoid bone, a sievelike bone at the base of the skull, behind the root of the nose S-192

Ethnologic dance D-14c

Ethnol'ogy, science which deals with the races and classifications of mankind A-264. *See also in Index* Anthropology; Archeology; Civilization; Evolution; Man; Races of mankind

Eth'yl, a chemical radical (C_2H_5) derived from ethane, existing in combinations.

Ethyl alcohol, or **grain alcohol** A-146, O-424b
 acetylene a source A-7
 fuel for engines F-314
 solvent for lacquer L-82
 wood sugars a source, W-187

Ethyl chloride, a compound of ethyl and chlorine (C_2H_5Cl)
 anesthetic A-246

Eth'ylene, a gaseous hydrocarbon (C_2H_4) of high fuel value
 anesthetic A-246
 formula, *diagram* O-424b
 illuminating gas contains G-31

Ethylene glycol, thick, sweet, colorless liquid, the simplest type of

Christian theologian first learned man of his age History of the Christian Church most important ancient record of church called *father of church history* chief figure at Council of Nicaea
Eusebius of Nicomedia called the Great (died A D 341?) leading defender of Arius and after death of Arius leader of his party a politician rather than a theologian banished from his see pardoned through sister of Constantine promoted to bishop of Nicomedia and later of Constantinople
Eustachian (ū stā kĭ an) tube connection between throat and middle ear F 171 picture N 307
Eustachius (ū stā kĭ ŭs) **Bartolommeo** (died 1574) Italian anatomist physician to Cardinal Peretti (later Pope Sixtus V) A 239
Eutaw (ū tô) **Springs** battle in Revolutionary War 1781 led British to abandon South Carolina near Santee River 60 mi nw of Charleston Americans led by Greene and Marion British by Stuart
Eutaw Standard flag F 130d *color picture* F 128
Euterpe (ū tẽr pē) in Greek mythology Muse of lyric poetry M 454
Euthanasia (ū thạ nā zhĭ ạ) painless death also painless killing especially of a person suffering *from an incurable disease*
Euthenics (ū thĕn ĭks) (from the Greek *meaning to thrive*) the study of methods to improve living conditions and human relationships
Euxinus ancient name of Black Sea B 204 *maps* B 204 E 417
Eva in *Uncle Tom's Cabin* by Harriet Beecher Stowe beautiful affectionate and exceedingly good child daughter of Uncle Tom's master Augustin St Clare
Evacuation Day (March 17) F 56
Evangelical Alliance association of members of Protestant churches organized in London 1846 extended to many other countries American branch organized 1867 purpose to strengthen Protestantism and to promote religious interest
Evangelical and Reformed church established 1934 formed by union of Evangelical Synod of North America (which originated with a synod organized at Gravois Settlement Mo 1840) and the Reformed church in the United States (established 1725 near Philadelphia Pa) accepts Bible as ultimate rule of life and faith For membership *see in Index* Religion *table*
Evangelical church a Christian religious body formerly the Evangelical Association founded among German speaking people in Pennsylvania about 1800 by Jacob Albright former Methodist about 213 000 members in U S in 1946 united with United Brethren in Christ to become the Evangelical United Brethren church (membership in 1952 about 724 000) In doctrine resembles *Methodist* church as does also the Evangelical Congregational church *formerly* United Evangelical church an independent body separated from the Evangelical Association in 1894
Evangelical United Brethren church *See in Index* Evangelical church United Brethren in Christ
Evangeline heroine of Longfellow's poem of that name real name Emmeline la Biche L 310
deportation of Acadians A 6
scenes of story N 309, N 184
statue *picture* A 6
Evangelists in the Bible writers of the New Testament Gospels of Matthew Mark Luke and John
Evans Sir Arthur John (1851 1941) English archaeologist knighted 1911 noted for excavations and scholarly writings on Aegean civilization (Palace of Minos Scripta Minoa)
Cretan excavations A 29
Evans Augusta Jane *See in Index* Wilson Augusta Jane Evans
Evans Edward Ratcliffe Garth Russell Baron Mountevans (born 1881) British naval officer and explorer entered navy 1897 member of British Antarctic Expedition assumed command after Robert Falcon Scott's death served in World War I promoted rear admiral wrote *South with Scott*
Evans Herbert M (born 1882) *anatomist and embryologist* born Modesto Calif discovered vitamin E research in *physiology of reproduction* and in endocrinology
Evans James *(1801–46)* Canadian Methodist missionary born Kingston upon Hull England went to Canada in 1823 served among Indians on St Clair River and Lake Superior 1840 became general superintendent of Northwest *Indian* Missions printed first texts and *hymnbooks* in Northwest and invented syllabic character still used by Cree Indians
Evans Mary Ann *See in Index* Eliot George
Evans Maurice (born 1901) English *actor manager* born Dorset England best known for Shakespearean acting first appeared in United States in 1935
Evans Oliver *(1755* 1819) inventor born Newport Del invented machine *for making teeth* for carding machines machinery for flour mills the first *high pressure* steam engine and a steam dredge A 503 R 59
Evans Robley *Dunglison* (Fighting Bob Evans) (1846 1912) U S Navy officer *born* Floyd Court House Va ordered to Chile 1891 and *with gunboat Yorktown* defied Chilean navy in 1898 a Santiago his ship *Iowa* fired first gun at Cervera's fleet *became* rear admiral 1901 chosen commander in chief U S *fleet 1907* with which he started around world but was *forced by ill health* to leave ship at San Francisco after rounding Cape Horn
Evanston Ill residential suburb of Chicago pop *73 641* Northwestern University National College of Education *Garret* Biblical Institute World headquarters Rotary *International* national headquarters W C T U *map, inset* I 38
Evansville Ind *shipping* point on Ohio River in s w corner pop 128 636 E *448* *maps* I 79 U 253
Evansville College at Evansville Ind Methodist founded *1854 at* Moores Hill Ind moved to Evansville and renamed *1919* *arts* and sciences
Eva Perón (*ā va pĕ rōn*) formerly **La Plata** (*la pla ta*) *Argentina*, city 35 mi s e of Buenos Aires and 5 mi inland from Ensenada its port on *Plata estuary* pop 207 031 National University meat packing and *petroleum* refining name of city changed from La Plata to Eva *Perón in* 1952 *maps* A 331, S 253
Evaporated milk *table* M 252
Evaporation E 449–50 W 63 L 263, *pictures* M 142c–d
eucalyptus dries swamps F 412
foods F 223
plants L 151 T 179
rainfall dependent on R 70
relation to floods F 143
salt manufacture S 29 *picture* S 30
sea O 336 Dead Sea P 44–5 Great Salt Lake G 185 Mediterranean M 166
temperature lowered by W 63 L 263
vacuum in vessels E 450 V 434
water cycle aided by W 61 *diagrams* C 453 W 61
winds influenced by W 150
Evarts William M (1818 1901) lawyer and statesman born Boston Mass chief counsel for President Johnson in impeachment trial U S attorney general 1868–69 secretary of state under Hayes U S senator from New York 1885–91 counsel in *Alabama* arbitration noted orator H 297
Eve in the Creation story of Genesis first woman formed of Adam's rib
in Milton's Paradise Lost M 260
in 15th century manuscript *picture* E 375
Eve Nicolas and his son Clovis (16th and 17th centuries) French book binders important in history of binding design introduced fanfare style patterns were originally geometrical but later filled in with scrolls palm leaves and *olive branches*
Eve Rodin's statue *picture* R 177
Evelina Fanny Burney's first and best novel told in form of letters early example (1778) of novel of domestic manners
Evelyn (*ēv lĭn* or *ĕv lĭn*) **John** (1620–1706) English diarist of the Commonwealth and Restoration held minor government positions D 82
Evening grosbeak G 218 219
Evening primrose a flowering plant of genus *Oenothera* (*ē no thē rạ*) flowers commonly yellow but also red pink rose and white P 410 *color picture* F 172
fuchsia related to F 313
how to plant *table* G 17
Evening primrose family *See in Index* Onagraceae
Evening star name given to the planet Venus when visible just after sunset sometimes applied also to other planets—Mars Jupiter Mercury and Saturn
***Eve of St Agnes* The** poem by Keats Madeline the heroine believing in an old superstition goes to bed supperless on St Agnes Eve that she may dream of her future husband Porphyro her lover who has hidden in her bedchamber arouses her with music and persuades her to flee with him
quotation from K 19
Everest Sir George (1790–1866) English surveyor and geographer superintended first survey of India 1823–43 first fixed position and altitude of Mount Everest height corrected to 29 028 ft by Survey of India 1952–54
Everest Mount in Himalayas (29 028 ft) loftiest mountain on earth E 450, *maps* A 407 C 259 I 54 *picture* A 409
expeditions to scale E 456 *picture* E 453
height, comparative *See in Index* Mountains *table*
Everett Edward (1794–1865) statesman and in decade preceding his death foremost American orator born Dorchester Mass Unitarian minister at 20 professor of Greek at Harvard at 21 member of House of Representatives 1825–35 gover

1846–53; later governor of Jamaica; author of a book on his travels.

Eyre, Lake, a shallow salt lake in South Australia; area about 3700 sq. mi.; discovered 1840 by Edward John Eyre; normally dry, but in 1950 heavy rainfall filled it: A-479, *maps* A-488, 478

Ezekiel (*ē-zē'ki-ĕl*) (Hebrew, "God will strengthen"), one of the major Hebrew prophets (author of 26th book of Old Testament), who was carried prisoner to Babylonia in 597 B.C.; he flourished about 592–570 B.C.: P-418, *picture* P-419

Ez'ra, "the Scribe," Hebrew priest and reformer (books of Ezra and Nehemiah); sent to Palestine in 458 B.C. by Artaxerxes to investigate condition of Jews; brought back observance of Mosaic law: J-353